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DIRECTORATE OF PLANS

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THE TU-134 AIRCRAFT WITH D-30 ENGINES

PROVISIONAL INSTRUCTIONS FOR OPERATIONAL FLIGHT AND PILOTING

Book 1

2nd Edition

(English-Language Version)

2

SECRET

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THE TU-134 AIRCRAFT

WITH D-30 ENGINES

PROVISIONAL INSTRUCTIONS

FOR OPERATIONAL FLIGHT

AND PILOTING

BOOK 1

2nd Edition

Revised and Supplemented

By The

USSR MINISTRY OF CIVIL AVIATION

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PROVISIONAL INSTRUCTIONS FOR OPERATIONAL FLIGHT AND PILOTING of the TU-134 AIRCRAFT with D-30 ENGINES

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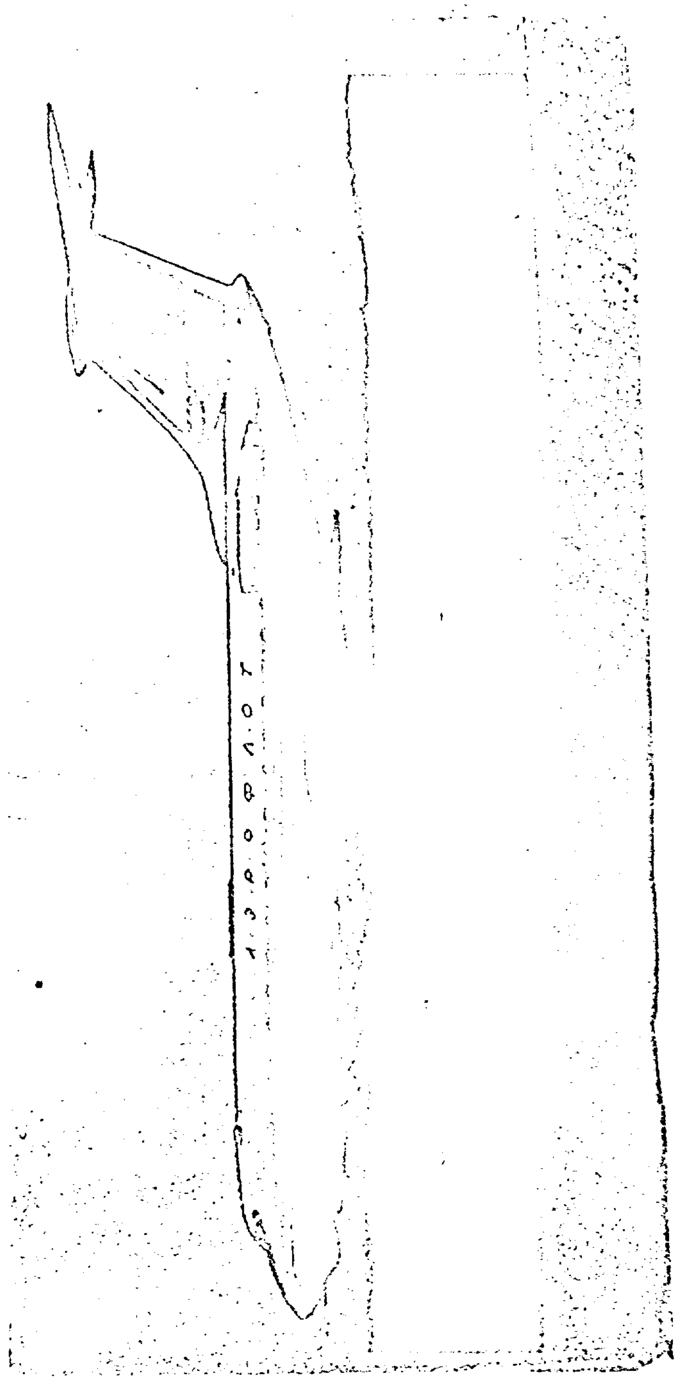

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INTRODUCTION

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GENERAL INFORMATION ON THE AIRCRAFT

The TU-134 aircraft with its two D-30 turbojet engines is designed for transporting passengers, luggage, and mail over short and medium air routes of 600 to 3,500 kilometers.

This aircraft is a low-wing cantilever monoplane of all-metal construction, with swept wings and tail surfaces, and with tricycle landing gear.

The principal distinguishing feature of this aircraft is the installation of its two engines at either side of the fuselage tailsection. This configuration offers several advantages, including:

-- reduction of noise- and vibration-levels in the passenger compartment;

-- improvement of wing-surface aerodynamics;

-- facilitation of power-plant service and maintenance.

The high cruising speed (800-900 km/hr), high performance ceiling altitudes (10,000-11,000 meters), and sophisticated autopilot, navigational, radio, and radar equipment, and also its automatic landing-approach equipment, all permit the use of this aircraft on all international air routes under difficult weather conditions.

Its great power reserves, extensive power-assist of wing [control surfaces], and reliable brakes assure excellent take-off and landing characteristics for the aircraft, and substantial attention has been devoted to the efficiency and reliability of its controls. The DR-134M yaw damper installed on this aircraft substantially facilitates handling, especially during bumpy flight or landing at minimum landing speeds in strong cross-winds.

The stabilizer on this aircraft has been made adjustable so as to provide a range of trim settings during takeoffs.

The main landing gear bogies of the aircraft are of unique design with rocker-type main struts. This design assures smooth shock-absorption during landing and ground turns.

A service door and hatch in the right side of the fuselage provide access to the forward and rear luggage compartments, which are completely isolated from the buffet and passenger compartments.

Flight safety of the aircraft is assured by:

-- the operational reliability of the D-30 engines;

-- installation of the engines on fuselage tailsection pylons;

-- operational flight ceiling above 10,000 meters altitude, i.e., above the cloud zone;

-- capability of continuing flight with one engine dead;

-- capability of continuing flight on one dead engine

0-7 465L at altitudes of 5,500-6,500 meters, with practically no reduction in range and while maintaining normal air-conditioning in the passenger compartment.

-- improved design stability of the pressurized section of the fuselage, especially at openings for windows, hatches, and doors, and of windowglass installation, precluding the

the possibility of cabin depressurization;

-- capability for rapid descent from higher to safer altitudes (in event of cabin depressurization) with landing gear extended;

-- incorporation of emergency-backup components in the primary systems and equipment of the aircraft;

-- incorporation of de-icing systems for leading-edge surfaces of wings, tail surfaces, and engine inlets, and for crew-compartment windows;

-- provision for rapid evacuation of the aircraft by both passengers and crew in event of wheels-up landing on dry land or water. For this purpose, the aircraft is provided with emergency exits according to ICAO standards and with special safety equipment (such as escape chute, inflatable escape slide, individual life jackets, emergency radio).

The passengers are assured of comfort during flight. Modern appointments of the passenger cabin interior, plush and comfortable seats with adjustable backs, and excellent sound proofing all contribute to passenger ease and comfort.

The aircraft purchaser has a wide choice of interior finish and color schemes to choose from.

The passenger cabin is equipped with an intercom radio system permitting the crew to provide the passengers with flight information, and a signalling system by means of which a passenger may summon steward service, either from his own seat or from one of the restrooms.

Ceiling-mounted indirect lighting provides primary illumination for the passenger compartments, and as this primary system is turned off, service illumination comes on, besides which each passenger has a personal light (as well as ventilation outlet) built into the overhead luggage rack.

An artificial microclimate is maintained in the passenger cabin by means of an air-conditioning system which maintains a 20°C temperature at all times of year and at all altitudes. Sea-level air pressure is maintained up to 6,000 meters altitude. During ascent to higher altitudes, the pressure gradually decreases, maintaining a constant ratio of 0.57 atmospheres between internal and external air pressure. At an altitude of 12,000 meters, cabin pressure is equivalent to atmospheric pressure at 2,400 m.

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S H E E T

For Listing Revisions and Supplements by Change Leaflet or by Bulletin

Item Nos.	Date	Change-Sheet or Bulletin No. Who Published the Bulletin, and in What Series	Section, Chapter, Subsection & Page	Who made & recorded changes
1	2	3	4	5

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REGISTRATION SHEET

TUPOLEV Designed Aircraft

Type TU-134 Passenger Aircraft with

D-30 Engines

Aircraft Manufactured in the USSR,

Identification No.

Design No. Series No.

U S S R

Built in 196...

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GEOMETRICAL SPECIFICATIONS

Height of Aircraft	9.02m
Length of Aircraft	35m
Maximum Diameter of Fuselage	2.9m

WINGS

Wingspan	29.0m
Wing Sweep Angle	35°
Aspect Ratio	7.3m
Wing Area:	
Including Protrusion	127.3m^2
Excluding Protrusion	115.0m^2
Average Aerodynamic Chord	4.318m
Wing Angle of Incidence	+1°

AILERONS

Aileron Span	2x5.15 = 10.30m
Area of Setback-Hinge Aileron, Excluding Blade (nozh)	9.68m^2
Area of Flettner-Flap Trimtab, Excluding Blade (nozh) (two)	2x0.187m^2 = 0.374m^2
Area of Flettner-Flap, Excluding Blade (nozh) (two)	2x0.164m^2 = 0.328m^2
Aileron Deflection Angle (up & down)	19°±1°
Aileron Trimtab Deflection Angles, (up and down)	3°±30'
Flettner-Flap Deflection Angles, (up and down)	6°±30'
Flettner-Flap and Trimtab Transfer Ratio	0.31

WINGFLAPS

Span of Wingflaps:	
Inner	5.41m
Outer	7.69m
Total Wingflap Area	22.5m^2
Inner Wingflap Deflection Angles:	
During Take-off	20° or 10°
During Landing	38°
Outer Wingflap Deflection Angles:	
During Take-off	18° or 9°
During Landing	35°

SPOILERS

Total Spoiler Area	4.48m^2
Spoiler Deflection Angle	52°±1°
Spoiler Span	7.01m

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FUSELAGE BELLY FLAP

Bellyflap Area	5.32m^2
Bellyflap Extension Angle	40°±1°
Bellyflap Width	02.8m

HORIZONTAL TAIL SURFACES

Horizontal Tail Surface Width	11.8m
Tail Surface Sweep Angle Along the 1/4-Chord Line	38°
Stabilizer Surface Area	24.263[m^2]
Total Horizontal Tail Surface Area	30.68[m^2]
Length of Horizontal Tail Surface	4.54[m]
Stabilizer Trim Setting Angles Relative to Fuselage Design-Horizontal:	
For Take-off up to	-4°(-2.5 on UPS*)
For Flight & Landing	-1°30'(0 on UPS*)
Elevator Surface Area (two)	6.417m^2
Elevator Deflection Angles:	
Upward	22°±1°
Downward	16°±1°
Elevator Trimtab Area (two)	0.684m^2
Elevator Trimtab Deflection Angles:	
Cable actuated (up & down)	8°±30'
Electrically actuated (up & down)	4°±30'

VERTICAL TAIL SURFACES

Vertical Tail Surface Sweep Angle Along the 1/4-Chord Line	40°01'
Vertical Tail Surface Area Including the Dorsal Fillet	21.25m^2
Rudder Area	5.7m^2
Rudder Deflection Angles (R. & L.):	
With Flaps Retracted	±5° [sic?]
With Flaps Extended	25°±1°
Rudder Flettner-Flap Trimtab Area	0.594m^2
Rudder Flettner-Flap Deflection Angles, (Right and Left)	17°30'±30'
Rudder Trimtab Deflection Angles(R&L)	3°30'±30'
Rudder Flettner-Flap Transfer Ratio	0.70

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* UPS = Stabilizer Position Indicator

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LANDING GEAR

Wheelbase (Struts not Compressed)	13.73m
Wheeltrack (Between Main Landing-Gear Bogies)	9.45m
Main-Bogie Wheel Size	930x305V
Nosewheel Size	660x200V
Nosewheel [Maximum] Deflection Angle During Take-off Run and Landing	±5°30'±30' [sic?]
Nosewheel [Maximum] Steering Angle During Taxiing	35°±1°

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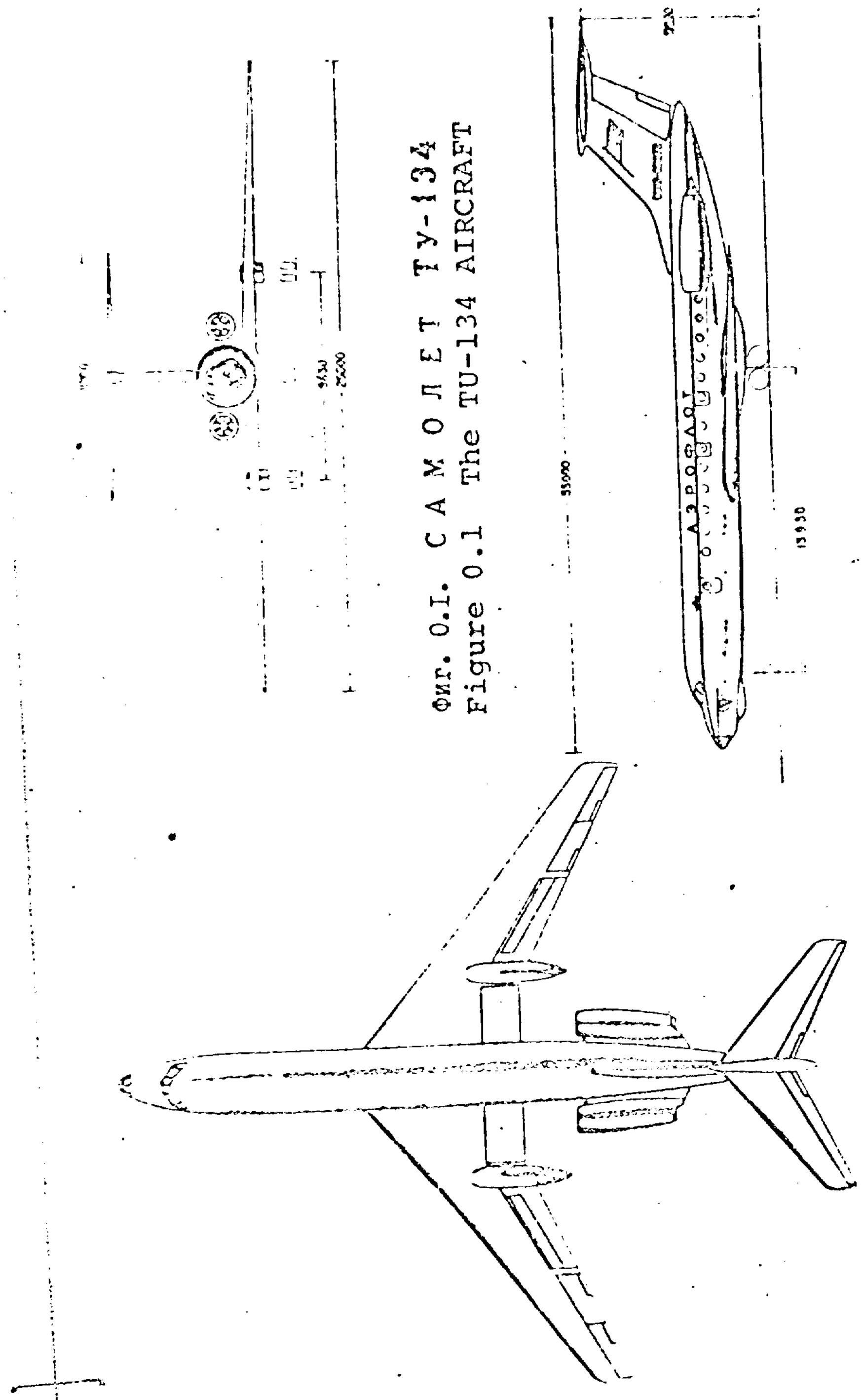

Фиг. 0.I. С А М О Л Е Т Т у - 1 3 4
Figure 0.1 The TU-134 AIRCRAFT

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D E F I N I T I O N S

Below are given some definitions and terms found in Section 3, "FLIGHT CHARACTERISTICS" [not available for translation].

Barometric Altitude....... Atmospheric pressure expressed in units of altitude, as per MSA. This is obtained by setting the fine barometric altimeter scale at 1013.2 millibars (760 mm Hg).

True Altitude............. The actual vertical distance between the lowest point on the aircraft in level flight and the corresponding point of reference on the terrain surface.

Outside Air Temperature... Temperature of the undisturbed air in the vicinity of the aircraft. This is determined by means of the Outside-Air Thermometers.

Weight.................... The total weight of the Aircraft, including fuel, oil, equipment, crew, and payload.

Atmosphere................ The aircraft may be operated in ambient air temperatures ranging from -70°C to +45°C.

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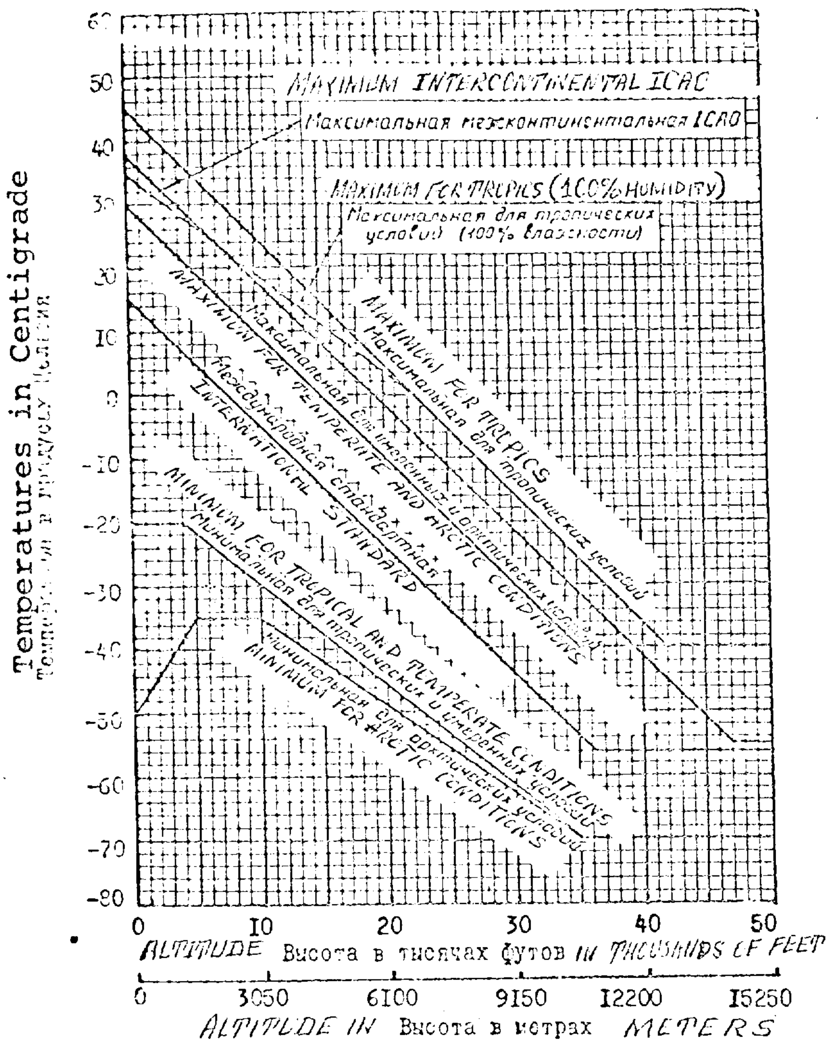

Фиг. 0.2 ХАРАКТЕРИСТИКА СТАНДАРТНЫХ КЛИМАТИЧЕСКИХ УСЛОВИЙ (ТЕМПЕРАТУРА, ВЫСОТА)

(Фиг. I из приложения гл. ДI-2 BCAR)

Figure 0.2 Standard Climatic-Condition Curve (Altitude & Temperature)

(Fig. 1 of insert to Ch. D1-2 BCAR)

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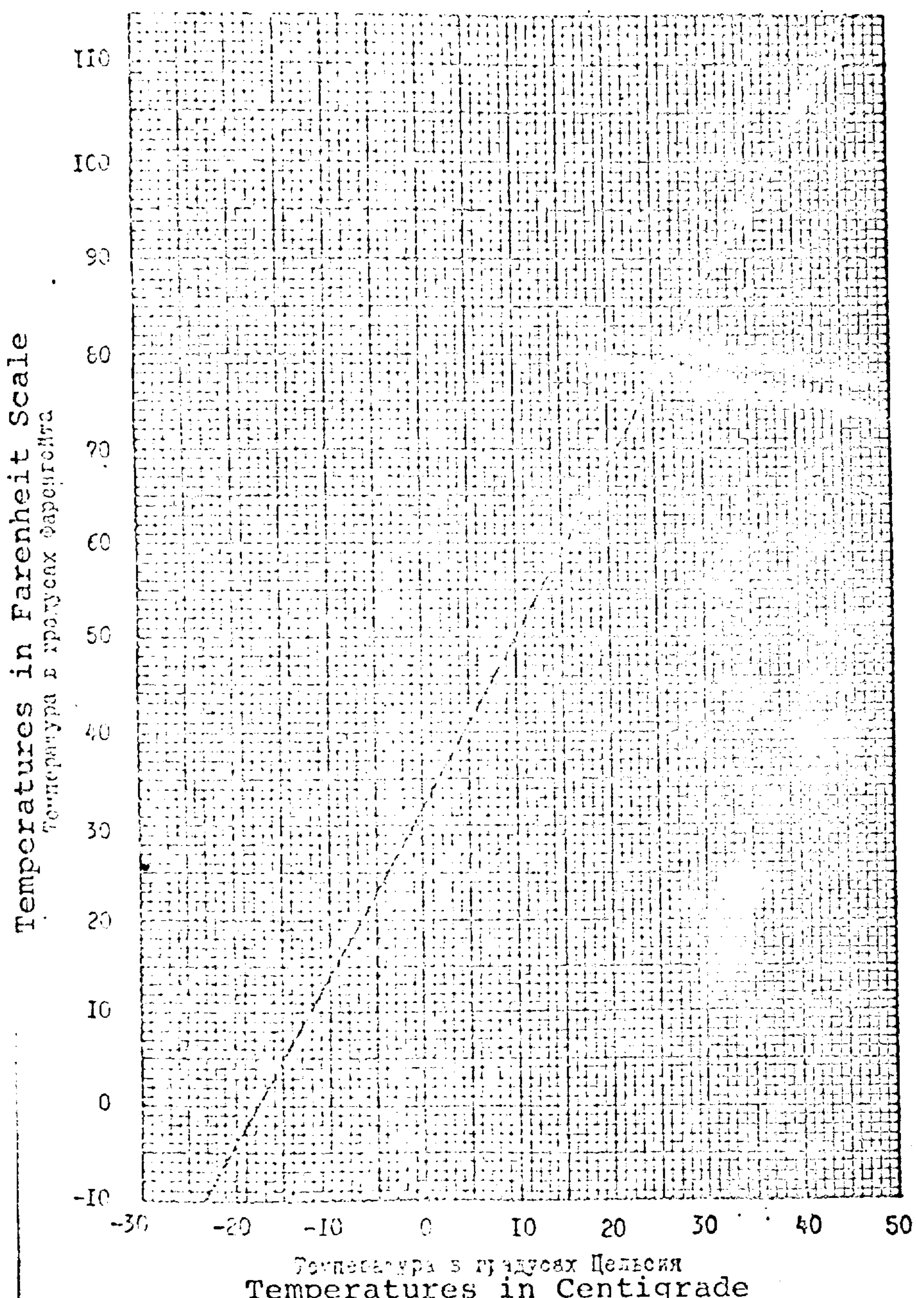

Фиг. 0.3 ПЕРЕВОД ТЕМПЕРАТУРЫ ИЗ ГРАДУСОВ ШКАЛЫ ФАРЕНГЕЙТА В ГРАДУСЫ ШКАЛЫ ЦЕЛЬСИЯ

Figure 0.3 Farenheit-to-Centigrade Conversion

SECTION 1

RESTRICTIONS AND PREPARATIONS FOR FLIGHT

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Chapter One

FLIGHT RESTRICTIONS

1. MACH-AIRSPEED RESTRICTIONS

1. The maximum-permissible operating indicated airspeeds [see:] Figure 1.1 are:

(a) with empty Nº 3 integral wingtanks (in wing outboard sections) -- 600 km/hr, but not greater than the Mach-limit [M_{mo}] of 0.82;

(b) with full Nº 3 wingtanks -- 500 km/hr, but not greater than the M_{mo} of 0.82*;

WARNING: Intentionally exceeding the Mach-airspeed limits indicated in Paragraph 1 is strictly prohibited in all flight modes, including emergency descent, while there are passengers aboard the aircraft.

2. The indicated-airspeed design limits are:

(a) with empty Nº 3 wingtanks -- 650 km/hr, but not greater than the Mmax.max. of 0.87;

(b) with full Nº 3 wingtanks -- 550 km/hr, but not greater than the Mmax.max. of 0.87.

3. In event of DR-134M yaw-damper failure, airspeed should not exceed $V_{\text{indic. norm.oper.}} = V_{\text{indic. limit}} = 550$ km/hr.

4. Maximum permissible emergency descent rate is 0.82.

5. Maximum permissible indicated airspeed with flaps extended: - in takeoff configuration ($\delta_3 \leqslant 20°$) -- 400 km/hr;

- in landing configuration ($\delta_3 = 38°$) -- 340 km/hr.

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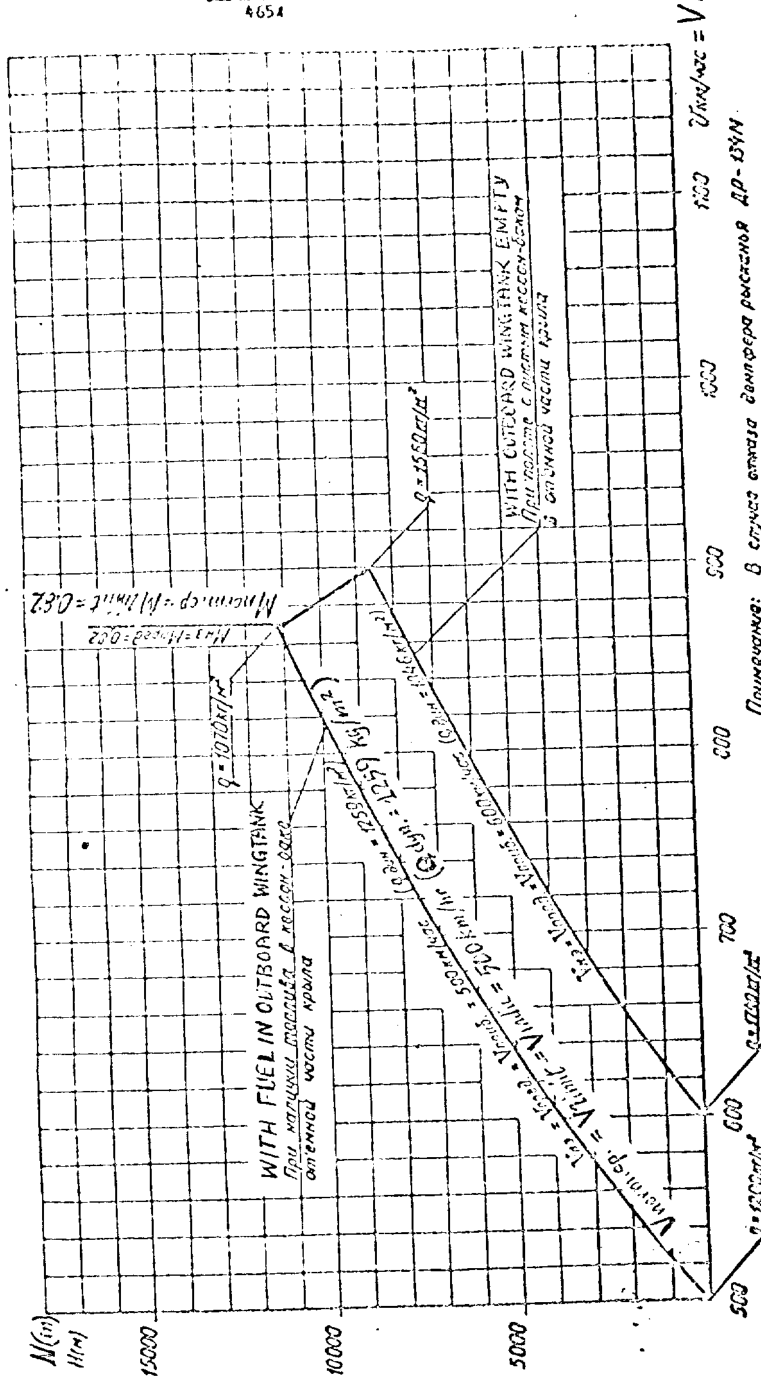
* Tank Nº 3 is used only with payloads of 5.5 tons or less over distances of more than 2,000 km, whereupon the fuel from Tank Nº 3 is used for pre-takeoff taxiing and while climbing to the cruising altitude of 11,000 meters.



Примечание: В случае отказа демпфера рыскания ДР-134М установлена $V_{нз}^{пред} = V_{пред}^{доп} = 550$ км/час

NOTE: Should the DR-134M Yaw Damper fail, then $V_{indic.} = V_{limit} = 550$ km/hr

Фиг. 1.1. График предельно-допустимых скоростей

Figure 1.1 CHART OF PERMISSIBLE MACH-AIRSPEED LIMITS

6. Maximum indicated airspeed with stabilizer trimmed for takeoff, or during trim-setting adjustment -- 400 km/hr.

7. Maximum indicated airspeed while landing-gear is being extended -- 400 km/hr; with gear extended -- 450 km/hr*.

1-3a/465L 8. Decreasing indicated airspeeds below those indicated in Table № 1 is strictly prohibited at all stages of flight except takeoff and landing, regardless of flying weight or altitude:

Table 1

Flap Deflection Angles	0°	10°	20-38°
Minimum Permissible Airspeed (km/hr)	330	300	270

The established minimum operating [control] airspeeds include a 20-30% margin over stall speeds.

In event of unintentional reduction of airspeed to 5-15% below the established minimum, the AUASP signal warns the pilot that he is approaching stall speed.

9. Minimum landing-approach airspeed with 38° of flap is 250 km/hr** at all flying weights.

---

* Emergency descent with landing gear lowered must not exceed an indicated airspeed of 600 km/hr.

**This 250 km/hr mimimum landing-approach airspeed for all flying weights is a temporary restriction. In connection with this limitation, landing-distance calculations (Sec. 3, Figure 3.55) for flying weights below(sic) 38 tons must provide for landing-distance increases proportional to the ratio K=38 t/G flying [weight].

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10. Minimum safe indicated airspeeds for takeoff (for starting climbout with one engine inoperative) are:

Tons Takeoff Weight	Km/hr Min. Safe Indic. Airspeed for Takeoff at Flap-Settings Shown	
	10°	20°
40	270	250
42	275	255
44	280	260

2. G-LOAD ALLOWANCES FOR VERTICAL MANEUVERS

G-load limits are based on the following criteria:

(a) Aircraft aerodynamics, i.e., value of the C_L allowance factor;

(b) Aircraft stability, i.e., the factor $\eta^e_{umax} = 2.5$.

The vertical-maneuver G-load allowance-limit values are established relative to flight altitude and Mach number according to the diagram illustrated in Figure 1.2.

3. AIRCRAFT ALTITUDE LIMITATIONS

Table 3 shows allowance-limit altitudes relative to flying weights:

Table 3

Tons Flying Weight	Meters Allowance-Limit Altitude
42	11,000
39	11,500
36 and less	12,000

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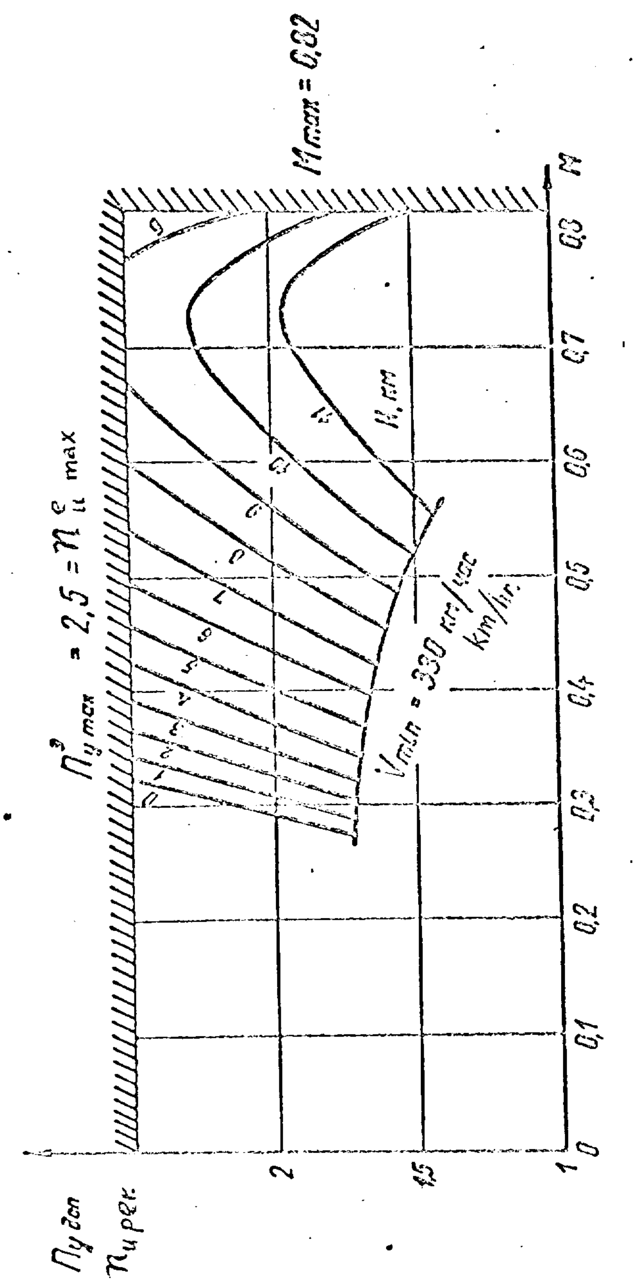

Фиг. 1.2. График предельно-допустимых перегрузок при вертикальном маневре самолета в зависимости от H и числа M

Figure 1.2 AIRCRAFT VERTICAL-MANEUVER G-LOAD ALLOWANCE LIMITS RELATIVE TO ALTITUDE AND MACH NUMBER

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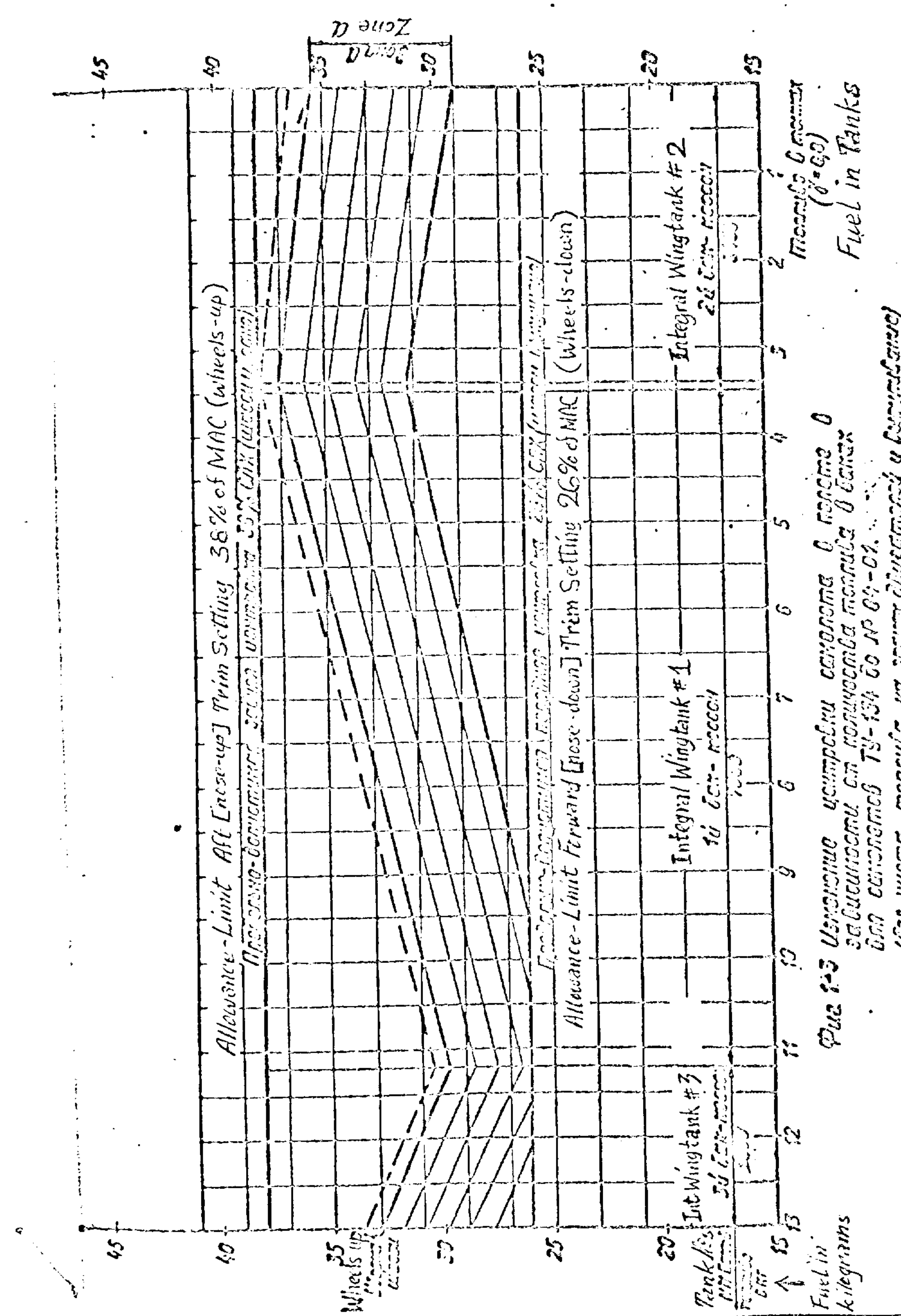

Figure 1.3 AIRCRAFT CENTER-OF-GRAVITY SHIFTS DURING FLIGHT RELATIVE TO CONSUMPTION OF FUEL FROM THE TANKS
Excluding fuel consumed in starting engines and taxiing
(for TU-134 Aircraft up to Nº 04-01)

4. AIRCRAFT TRIM-SETTING ALLOWANCES

1. Allowance-limit foreward [nose-down] trim-setting for takeoff, flight, and (wheels-down) landing is 26% of MAC [mean aerodynamic chord].

2. Allowance-limit aft [nose-up] trim-setting for takeoff, flight, and (wheels-up) landing is 38% of MAC.

3. Destabilization trim-setting is 51.5% of MAC.

5. AIRCRAFT WEIGHT LIMITATIONS

1.	Maximum taxiing weight	44,200 kg
2.	Maximum takeoff weight	44,000 kg
3.	Normal landing weight	37,000 kg
4.	Maximum landing weight	40,000 kg
5.	Maximum emergency-landing weight	44,000 kg
6.	Maximum payload, includes:	7,700 kg
	Passengers (72 persons)	5,400 kg
	Luggage, freight, & galley products	2,300 kg
NOTE:	Fuel-weight maximum therewith	9,500 kg
	Fuel-weight + payload maximum	17,200 kg
7.	Maximum Centralized-intake fuel capacity (fuel density 0.8)	13,200 kg

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6. POWER-PLANT LIMITATIONS

Table 4 shows the primary engine operating modes for operation in normal atmospheric conditions.

NOTE TO TABLE 4:

1. Engine operating parameters given in this table make no allowance for air bled off for auxiliary systems.

2. With auxiliary-systems bleed-air disconnected, on the ground and in all flight modes except takeoff, turbine exhaust gas temperatures may be increased in increments to as much as 20°C, and up to the PRT-35 system temperature limit in takeoff mode.

3. Engine rotor rpm may fluctuate from the indicated settings as follows: for the first stage, within ±0.35% on the ground and ±0.5% in flight; for the second stage, ±0.25% on the ground and ±0.45% in flight.

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Таблица 4

Режимы (a)	Время непрерывной работы (мин) (f)	(i) Для H=0 V=0: Обороты ротора 1-го каскада (для сведения) (100%=8521 об/мин) (j)		Обороты ротора 2-го каскада (100%=11677) об/мин (m)		Температура газов за турбиной °C (не более) (o)	Для H=11000м (q) (r) M=0,75: Обороты ротора 1-го каскада (для сведения) (j)		Обороты ротора 2-го каскада (m)		Температура газов за турбиной °C (не более) (o)	Температура масла на входе в двигат. °C (s)	Давление масла на входе в двиг. кг/см² (u)	Давление топлива на входе в насос-регулятор (НР-30) кг/см² (w)
		%	об/мин (k)	%	(k) об/мин		%	об/мин (k)	%	об/мин (k)				
Взлетный (b)	5 (не более) (g)	[illegible]	$7750^{\pm75}$	98,5 100	11600^{+50}_{-100}	620	93,0 94,0	7950^{+50}_{-25}	97,5÷ 98,5	11420^{+50}_{-100}	630	Рекомендуемая +50÷+70, минимально-допустимая -30°, максимально-допустимая +80°, макс.-доп. на время не более 10 мин. +90° (t)	3,5÷4,5 (не менее) 2,5 (v)	1,8÷2,9
Номинальный (c)	Не ограничено (h)	79,5÷ 81,5	$6850^{\pm75}$	92,5 94,0	10900^{+50}_{-100}	530	86,5 88,5	$7450^{\pm75}$	92,5÷ 94,0	10900^{+50}_{-100}	540			
0,9 номинальн. (d)		76,0÷ 78,0	$6550^{\pm75}$	90,0 91,5	10650^{+50}_{-100}	495 (для свед)	83,5 85,0	$7180^{\pm75}$	90,5÷ 91,5	10650^{+50}_{-100}	505 (для свед)			
0,7 номинальн.		70,0÷ 72,0	$6050^{\pm75}$	87,0 88,5	10250^{+50}_{-100}	(p) 450 (для свед)	78,0 80,0	$6720^{\pm75}$	87,0÷ 88,5	10250^{+50}_{-100}	(p) 460 (для свед)			
0,6 номинальн.		66,5÷ 68,5	$5750^{\pm75}$	85,0 86,0	10000^{+50}_{-100}	420 (для свед)	75,0 76,5	$6450^{\pm75}$	85,0÷ 86,0	10000^{+50}_{-100}	430 (для свед)			
0,35 номинальн.		63,5÷ 65,5	$5500^{\pm75}$	83,0 84,5	9800^{+50}_{-100}	400 (для свед)	-	-	-	-	-			
Малый газ (e)		-	-	61÷62,5	$7200^{\pm100}$	360 (для свед)	-	-	-	-	-			

TABLE 4. POWER PLANT LIMITATIONS

a. Modes
b. Takeoff
c. Rated
d. ...of Rdted
e. Idling
f. Uninterrupted operating time (min)
g. (at most)
h. Unrestricted
i. For...
j. First-stage rotor speed (for data)(8521 rpm = 100%)
k. rpm
m. Second-stage rotor speed...
o. Turbine exhaust-gas temperatures in degrees Centigrade
p. (for data)
q. H = 11000 m
r. M = 0.75
s. Engine input oil temperatures in °C
t. Reccommended: +50° to +70°
Minimum permissible: -30°
Maximum permissible: +80°
Maximum permissible for not longer than 10 minutes: +90°
u. Engine input oil pressures in kg/cm²
v. (at least)
w. Fuel pressures at inlet of apportioning pump (NR-30), in kg/cm²

4. Ambient temperature, at start of restriction of the fuel consumption maximum while in takeoff mode at 760 mm Hg, equals +15°C.

5. The takeoff mode is used during takeoff and also in some special flight situations.

6. Restrictions associated with operation of the engines are indicated in the NOTES and CAUTIONS in the text of the Power Plant portion of Section 2.

7. For cruising flight, the engine operating mode should not exceed n=90.5-91.5% (10650^{+50}_{-100} rpm).

8. The rated engine operating mode of n=92.5-94.0% (or 10900^{+50}_{-100} rpm) is limited by 40% of potential and is used for gaining altitude and in special flight situations.

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7. VARIOUS [OTHER] RESTRICTIONS

1. Upon entering an area of icing conditions, every effort should be made to get out of such an area as quickly as possible. The engines must not be operated in the modes $n\bar{n}$ = 77-83% while in icing conditions.

2. Maximum allowance for crosswind during takeoff and landing is 14 m/sec.

The maximum wind allowance for taxiing in or out, or for towing the aircraft, is 30 m/sec. The elevators and rudder should be locked when towing the aircraft in winds of 15 m/sec and greater.

3. Takeoff mode maximum: The engines may be operated for up to 5 minutes in the take-off mode 98.5% (n=11600 rpm).

4. Maximum in-flight engine-restart altitude: 7,000 m.

5. Operational cabin-pressure differential: 0.57 atm.

6. Smoking is prohibited during takeoff, climbout, descent, and landing.

7. The autopilot must not be engaged below 1,000 m altitude, below 350 km/hr and above 600 km/hr airspeed, or above Mach 0.82.

In case of autopilot longitudinal-channel failure when flying at the airspeed limits, the aircraft may be accelerated briefly to indicated airspeeds of 620-630 km/hr or Mach 0.83-0.85.

In the event of self-induced oscillation of the aircraft control elements, and upon encountering buffeting, the autopilot should be disengaged.

8. Table 5 shows load limits of freight and baggage compartment floors.

9. Landing lights must not be extended at airspeeds above 400 km/hr.

10. The spoilers must not be extended during flight before the wheels contact the runway.

11. Minimum width of runway required to permit 180° taxiing turn without braking inside-bogie wheels is 60 m.

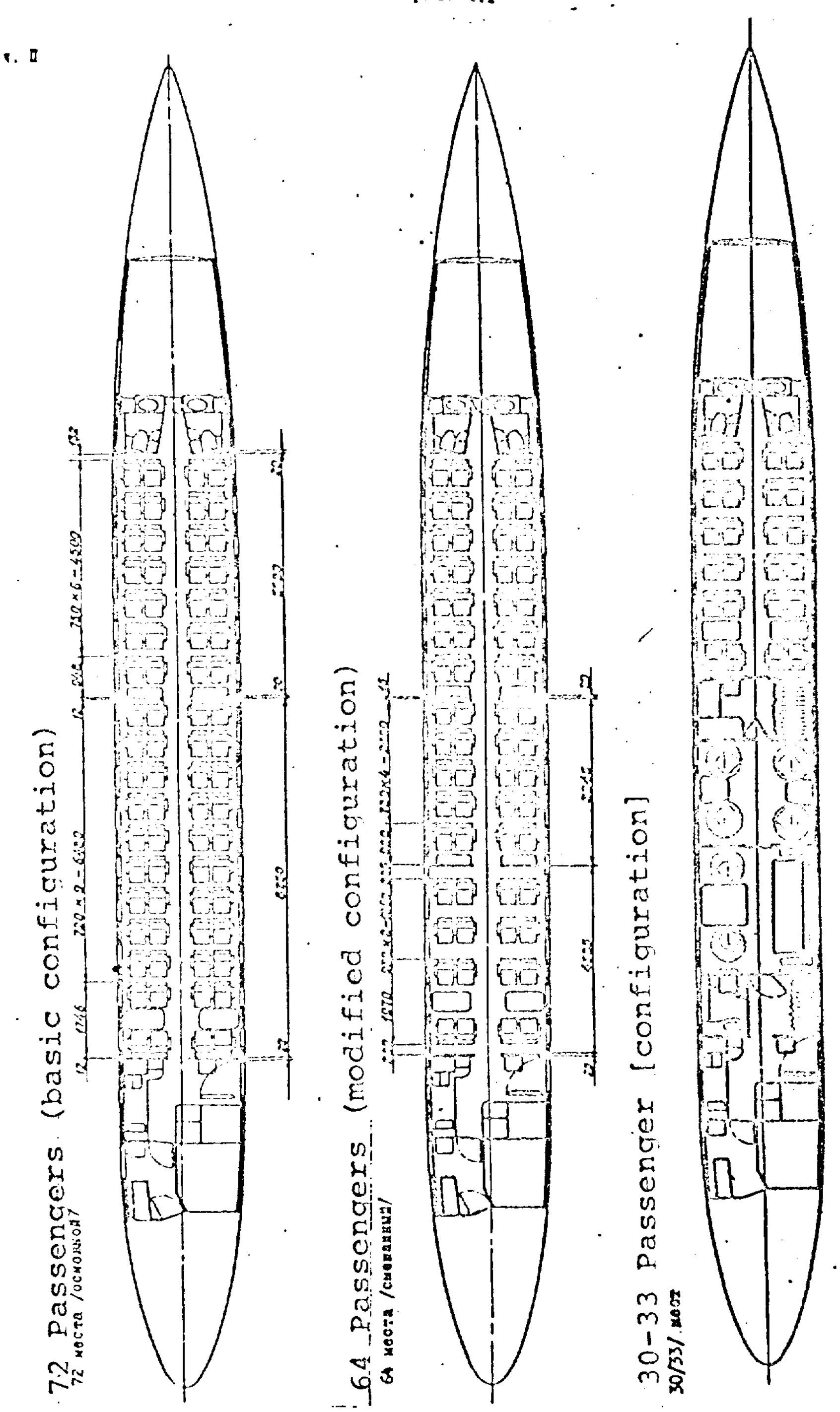

Figure 1.4 TU-134 AIRCRAFT FUSELAGE [CABIN] CONFIGURATIONS

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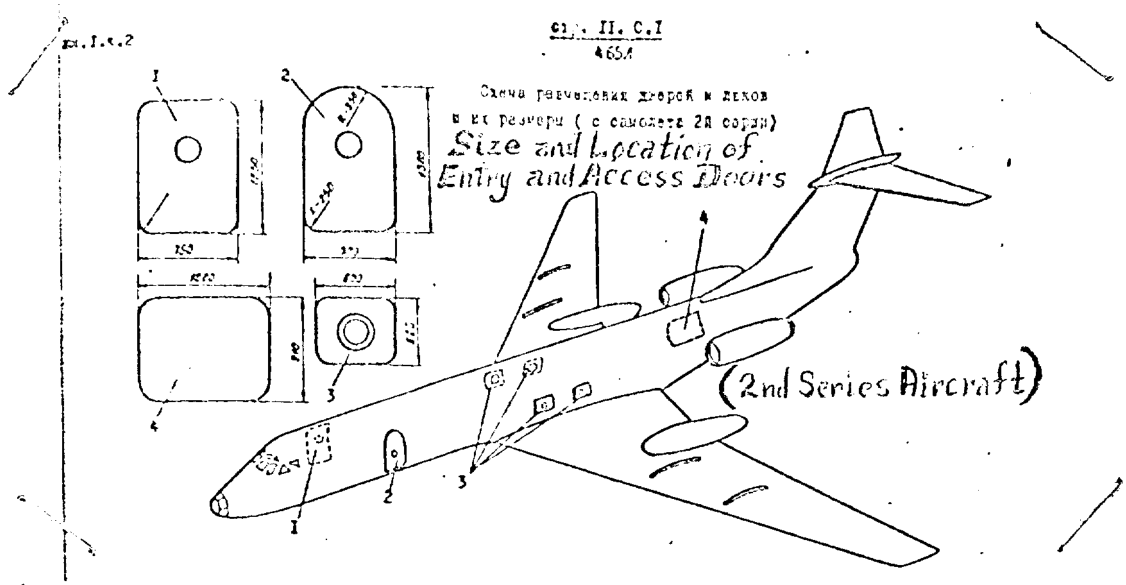

Figure 1.5 TU-134 AIRCRAFT FUSELAGE CONFIGURATION (2nd SERIES) 72-PASSENGER ACCOMMODATION

1. Service door (right side)
2. Entry door (left side)
3. Escape hatches over wings
4. Aft baggage access hatch (right side)

Baggage Compartment Sizes and Volumes (2nd-Series Aircraft)

Table 5

Com-part-ment	Usable space in m^3	Floor area in m^2	Specific floor load alowance in kg/m^2	Maximum floor load alownce in kg	Compartment Capacities in kg, loaded as shown: Passengers luggage at 150 kg/m^3	Mail and freight at 300 kg/m^3
Fwd	2.9	1.78	600	1070	440	870
Aft	8.3	4.35	500	2180	1250	2180*
Total:	11.2	6.13	----	3250	1690	3050

* Restricted by the size of the floor area

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465L

Chapter Two

FLIGHT PREPARATIONS

Preparation for flight entails the following steps:

-- filing a flight plan, checking weather conditions, and calculating optimum flight mode;

-- computing fuel load, requirements, and normal consumption rates for the given range, altitudes and winds;

-- fueling the aircraft according to flight plan;

-- checking payload distribution for conformity to center-of-gravity requirements;

-- determining takeoff safety conditions, contingent on starting conditions, in case of engine failure on takeoff;

-- preflight inspection check of aircraft by crew.

1. CALCULATING OPTIMUM FLIGHT MODE

The choice of flight mode depends on the non-stop sector distance to be flown, as well as on cruising speeds and altitudes.

The optimum altitudes and airspeeds are shown in Tables 6 thru 8, and by the graphs in Figure 1.6.

Figure 1.7 should be used to calculate the wind-factor value W equiv. (longitudinal wind component), obtaining the wind speeds and directions from winds-aloft reports.

If the wind factor increases more than 50 km/hr per 1000 meters increase in altitude, then the lower altitudes should be used.

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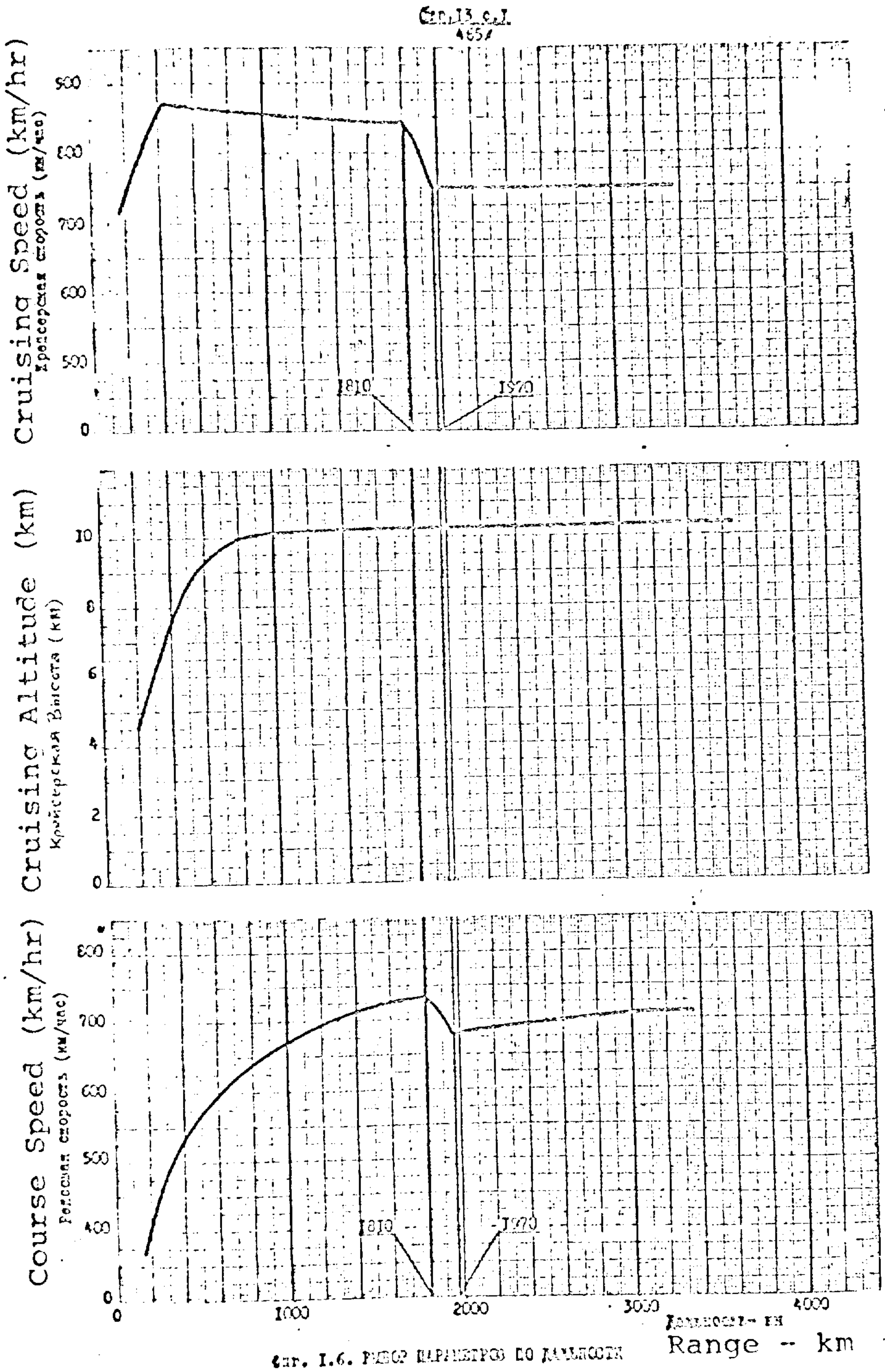
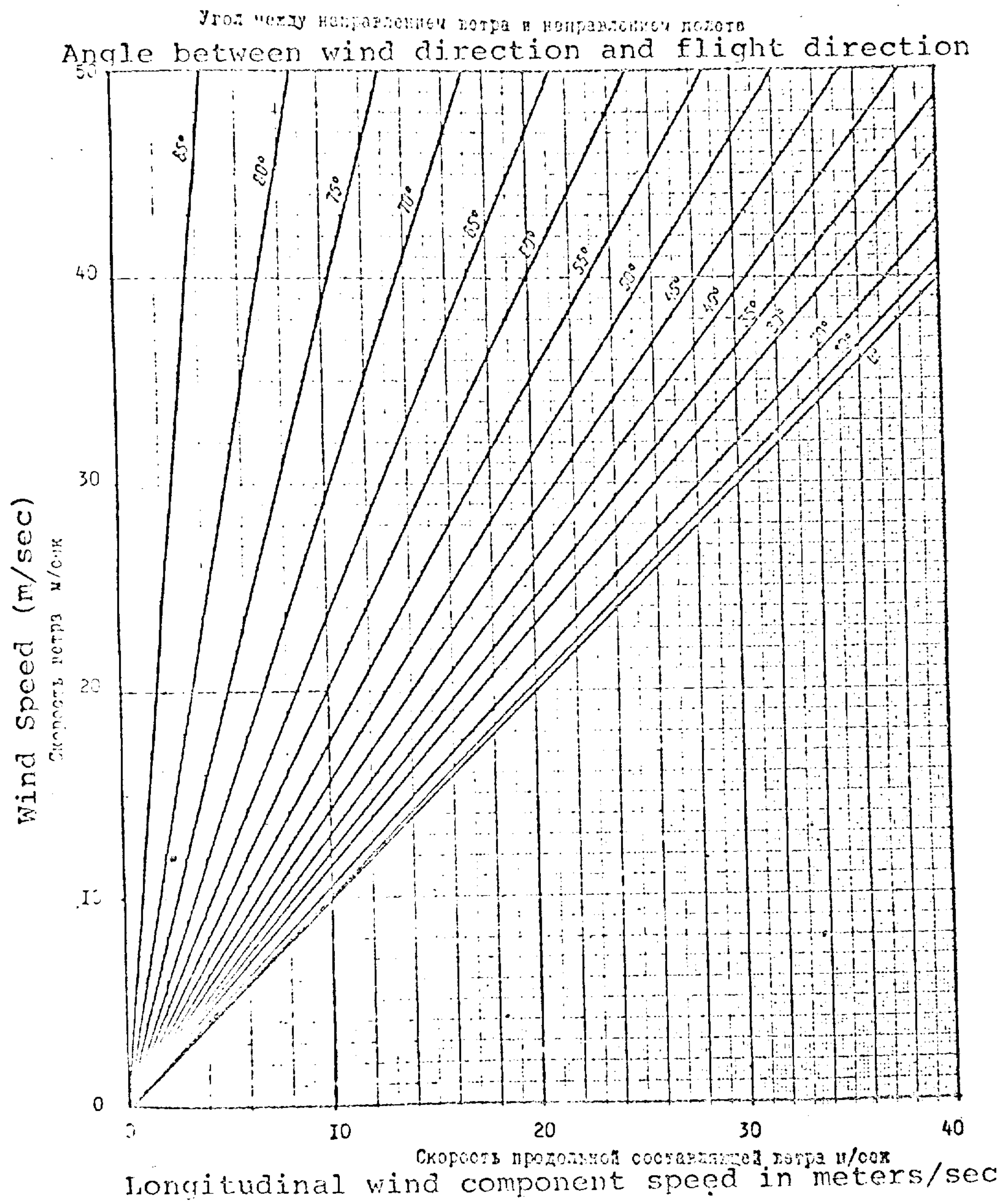


Figure 1.6 SELECTION OF FLIGHT-RANGE PARAMETERS



Фиг. I.7. ПРОДОЛЬНАЯ СОСТАВЛЯЮЩАЯ ВЕТРА

Figure 1.7 LONGITUDINAL WIND COMPONENT

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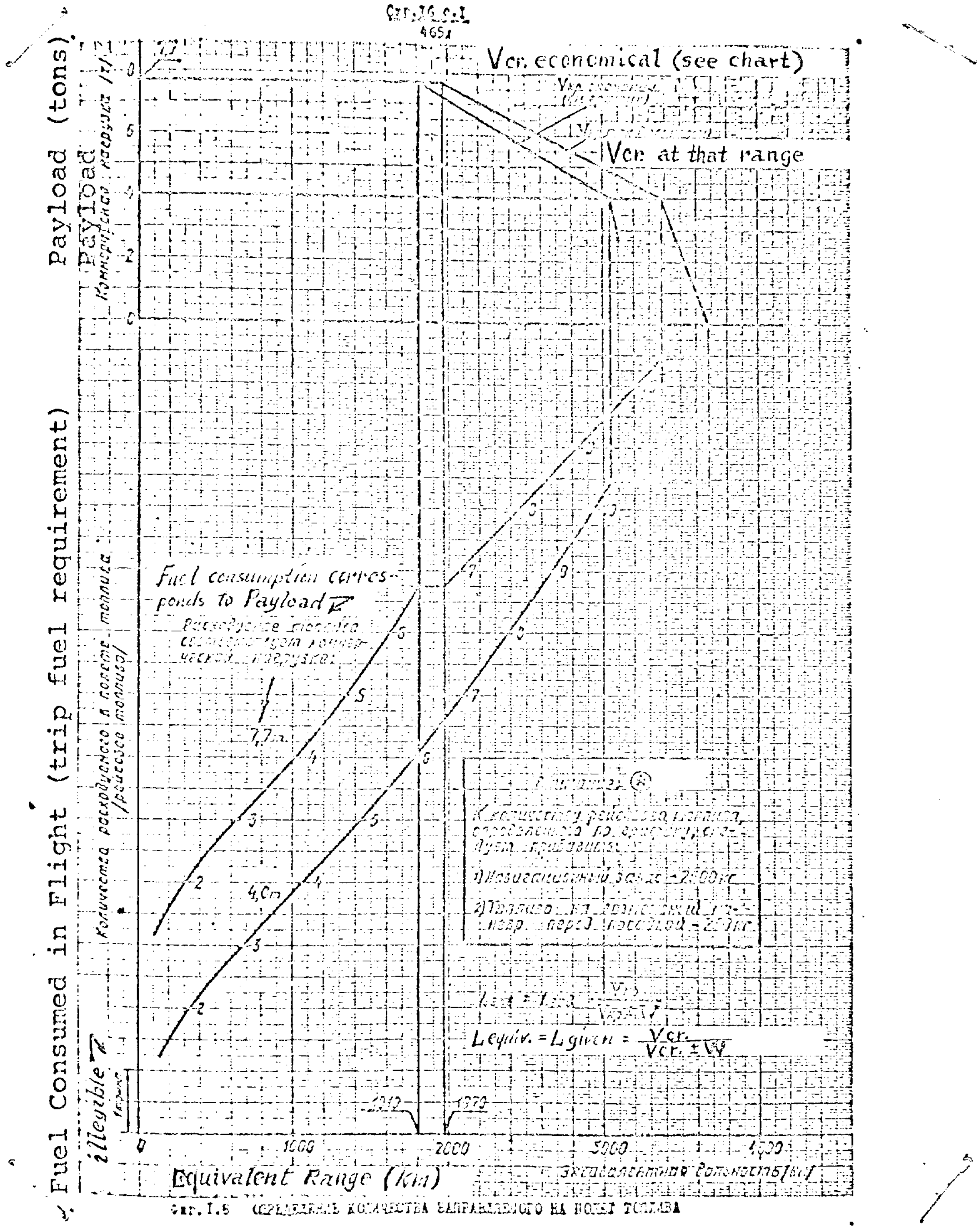

Figure 1.8 DETERMINATION OF TRIP FUEL REQUIREMENTS

⊛ ВНИМАНИЕ* = *ATTENTION

The trip fuel requirements determined by using this graph should be supplemented by the following amounts

(1)	navigational reserve	2500 kg
(2)	holding-pattern reserve	250 kg

In calculating trip airspeeds, a 12-minute allowance should be made for takeoff and for both air and ground maneuvers (besides time used in climbing, level flight, and descent for landing).

1-15/465L The airspeeds presented (in Figure 1.6) correspond to [the most] economical cruising speeds.

2. CALCULATING AIRCRAFT FUEL REQUIREMENTS

The graph shown in Figure 1.8 is used to calculate the quantity of fuel required to transport a given payload over a given distance, allowing for wind factors:

$$L \text{ equiv.} = Z \text{ given } \frac{V\ cr}{V\ cr. \pm W \text{ equiv.}}$$

The graph shows fuel requirements as follows:

--	for starting engines and taxiing	200 kg;
--	for takeoff	250 kg;
--	for landing and taxiing thereafter	250 kg;
--	for climbout, level flight, and descent	[--- --].

The sum total of these requirements constitutes the trip fuel requirement value as expressed in Figure 1.8.

Besides this, the figure obtained according to the graph in Figure 1.8 must be supplemented by 2500 kg for the navigational reserve, and by another 250 kg for any pre-landing [holding-pattern] maneuvers required.

1-16a/465 L In the event that a flight must be made under conditions (such as maintaining assigned altitudes and airspeeds according to schedule and atmospheric conditions) other than optimum flight conditions (see page 41 and tables 6, 7, & 8), the total trip fuel requirement for a given payload over a given distance at an assigned altitude in calm weather is determined according to tables A, B, and C.

Таблица А.

Высота 8000 м Altitude

Table A

Distance Дальность	0	100	200	300	400	500	600	700	800	900
0	–	–	–	4700	5030	5330	5900	6170	6530	6900
1000	7280	7650	8020	8700	8760	9150	9500	9500	9500	9800
2000	10100	10400	10720	11000	11530	11650	11950	12250	12550	12860
3000	13200x)	–	–	–	–	–	–	–	–	–

1800++)

Таблица Б.

Высота – 9000 м Alt.

Table B

Distance Дальность	0	100	200	300	400	500	600	700	800	900
0	–	–	–	4570	3920	5260	5620	5960	6300	6660
1000	7000	7360	7720	8090	8430	8790	9140	9500	9500	9550
2000	9820	10100	10380	10650	10950	11220	11500	11800	12060	12350
3000	12540	12910	13200x)	–	–	–	–	–	–	–

1885++)

Таблица В.

Высота – 10000 & и 11000 м Alt.

Table C

Distance Дальность	0	100	200	300	400	500	600	700	800	900.
0	–	–	–	–	4920	5250	5550	5890	6220	6550
1000	6860	7200	7520	7850	8200	8500	8850	9170	9500	9500
2000	9650	9890	10150	10400	10650	10900	11170	11450	11700	11950
3000	12200	12450	12720	13000	13200x)					

1950++)

x) Distance corresponding to a maximum fuel load and a payload of 4 tons.
++) cf NOTE to Tables A, B, and C, [below]

1-16b / 465 L NOTE TO TABLES A, B, & C, [above]:

(a) Cruise speed is selected relative to flight range 850 km/hr:
-- up to 1600 km inclusively at 8000 m altitude
-- up to 1700 km " " 9000 m "
-- up to 1800 km " " 10000 & 11000 m "

(b) When flying over distances exceeding those shown in (a) above, a reduction in airspeed is advised. The distances (++) given in Tables A, B, & C, are those beginning with which cruising speeds are limited to 750 km/hr with reduced payload values.

Example of Trip Fuel Requirements for Conditions Other Than Shown in Tables A B & C

(requirements obtained by approximation method)

Trip Flight Distance	1300 km
Payload	6 tons
Assigned Altitude	9000 m
Headwind	50 km/hr

MSA [International Standard Atmosphere]

1. Determining the Cruise Speed

The 1300 km trip distance is less than the 1700 km (as shown in Table B) range which restricts cruise speed, and an airspeed of 850 km/hr is therefore advantageous.

2. Figuring Approximate Equivalent-Distance Value by the Equation:

$$L\ \text{equiv.} = L\ \text{given}\ \frac{V_{cr}}{V_{cr} \pm W\ \text{wind}};$$

$$L\ \text{equiv.} = 1300\ \frac{850}{850-50} = 1380\ \text{km}.$$

3. Determining Approximate Aircraft Takeoff Weight

(a) using Table B, we obtain a value of 8430 kg of fuel for a trip distance of 1380 km (≈1400 km);

(b) we find the aircraft starting weight by adding the 8.43-ton weight of the fuel and the 6.0-ton weight of the payload to the 27.0-ton weight of the flight-ready aircraft:

$$27.0 + 8.43 + 6.0 = 41.43\ \text{tons}.$$

Takeoff weight is some 0.2 ton less than starting weight, by virtue of the fuel consumed prior to the actual start of the trip:

41.43 - 0.20 = 41.23 tons.

4. Determining Flight Range at Obtained Takeoff Weight

1-16c
465 L

(a) the 8.43 tons of fuel divides into:

2.50 tons for navigational reserve (ANZ);

0.20 ton for engine start and warmup, and for taxiing to the starting apron (fueled above takeoff weight limits);

0.25 ton for takeoff, turning, and getting on course;

0.50 ton for possible holding-pattern, landing, and subsequent taxiing maneuvers.

3.45 tons total

8.43 - 3.45 = 4.98 tons for climb, cruise, and descent

(b) Calculation of the Distance:

(41.23 tons takeoff weight, 9000 meters altitude, 850 km/hr airspeed, 6.0 tons payload).

Nº	Flight Stage	Fuel (tons)	Distance (km)
1.	Start	0.200	-
2.	Takeoff	0.250	-
3.	Climb	1.030	141
4.	Cruising	3.730	1054
5.	Descent	0.220	155
6.	Landing	0.500	-
	Totals:	5.930	1350
	Navigational Reserves	2.500	-
	Sum total:	8.430	-

The norms are taken from Item 4A in the form given and then, using the graphs in Figures 3.20, 3.21, and 3.48, we establish the quantities of fuel (1.03 & 0.22 tons) and the ranges (145 & 160 km) of the climbing and descent stages, respectively.

We use the following formula to find the (wind-corrected) distances of the ascent and descent stages:

$$L \text{ windy} = L \text{ windless} \; \frac{V_{cr.} \pm 0.5 W_{wind}}{V_{cr.}}$$

climbing: $$L \text{ "} = 145 \cdot \frac{850-0.5 \times 50}{850} = 141 \text{ km}$$

descent: $$L \text{ "} = 160 \cdot \frac{850-0.5 \times 50}{850} = 155 \text{ km}$$

1-16d / 465 L We enter these values on the form.

We determine the amount of fuel consumed during the cruising sector of the flight:

$$5.93-(0.20+0.25+1.03+0.22+0.50) = 3.73 \text{ tons.}$$

In order to find the average flying weight, we subtract from the takeoff weight the quantities of fuel consumed in takeoff, climbing, and half the cruising distance:

$$41.23-(0.25+1.03+0.5 \cdot 3.73) = 38.09 \text{ tons.}$$

The graph (in Figure 3.40) is used to find the specific distance per unit fuel consumption, 0.312 km/kg, corresponding to a gross weight of 38.09 tons at an airspeed of 850 km/hr.

The flight Mach number is found as follows:

$$M = \frac{V}{a} = \frac{850}{1093} = 0.777.$$

The K^1 value (Figure 3.35) corresponding to this Mach number is then 0.962.

The final value of the specific distance per unit fuel consumption is thus:

$$0.962 \cdot 0.312 = 0.3 \text{ km/kg},$$

whence the cruising-flight-sector distance comes to: 3730 x 0.3 = 1120 km, and its wind-corrected value becomes:

$$1120 \frac{850-50}{850} = 1054 \text{ km.}$$

The total distance is thus:

$$141+1054+155 = 1350 \text{ kilometers.}$$

This means that our previously selected fuel requirement figure (8.43 tons) provides for a flight of the specified range with a 50-km (150 kg) reserve of fuel. Consequently, we may take 8300 kg as the fuel servicing-requirement figure.

1-16e
465 L

Figure 1.8a CORRECTION COEFFICIENT FOR COMPUTING SPECIFIC RANGES IN CALCULATING STATE TEST RESULTS

1-17
465L

3. PREFLIGHT AIRCRAFT INSPECTION AND CHECKOUT BY CREW

Preflight inspection and checkout of the aircraft is done by the crew on the day of the flight, prior to towing the aircraft to the passenger terminal.

Prior to the arrival of the Captain (Aircraft Commander), the Copilot, Navigator, and Steward(ess) are expected to complete all the procedures especially outlined for each of them in the subsections presented below:

Aircraft Checkout by Copilot*

(a) Preliminary Procedures

1. Ascertain that the aircraft has aboard its airworthiness certificate, its registration certificate, the manufacturer's documentation (formulyar), and performance certificate (attestat). Check preflight maintenance and servicing of the aircraft for conformity with aircraft- and engine-manufacturers' documents; fill in the maintenance and servicing records and take over the aircraft from the maintenance service crew.

2. Be sure the fire-protection equipment is nearby the aircraft, that the main landing-gear wheelchocks are in place, the aircraft is properly grounded, the engine intake area is clear of stones, and in winter, that the engine intake areas and those under the wheels are clear of snow and ice.

---

* In the event that the crew includes a Flight Engineer, the Copilot performs only those checks outlined in items 8-17.

3. Be sure all hoods and intake covers are removed from the aircraft, except the engine air-duct intake covers (which are removed only immediately prior to starting the engines).

4. During wintertime, be sure ice and snow have been properly removed from all aircraft surfaces, engine air-duct intakes, crew- and passenger-cabin windows, all suspension and control elements of the ailerons, elevators, rudder, flaps, slats, spoilers, [belly] landing flap and trimtabs, exterior antennas, and external-air thermometer and pitot head intakes.

NOTE: Soft-soled shoes or special mats must always be used when walking on aircraft surfaces during inspection.

(b) Aircraft Exterior Inspection

5. Make an inspection tour of the aircraft exterior in the sequence and to the extent outlined in Figure 1.9.

During this inspection tour, check the following:

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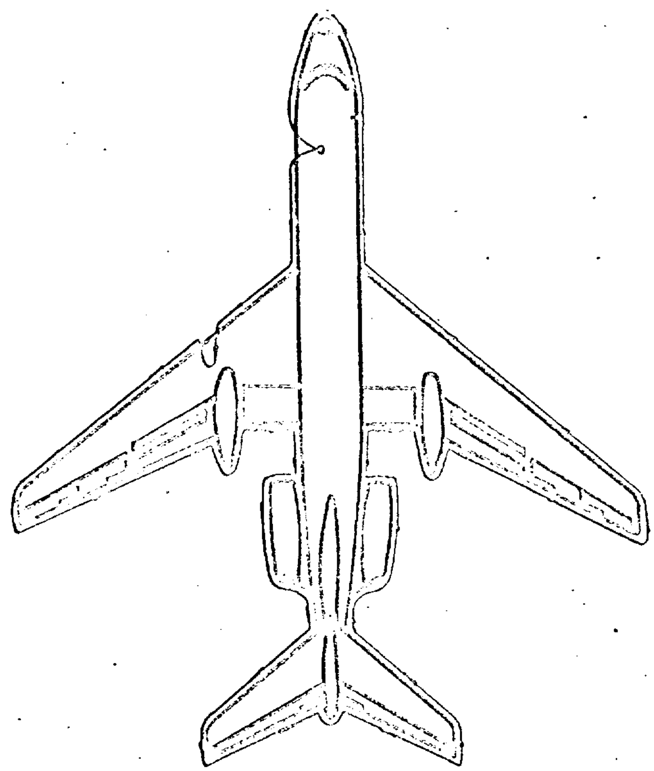
Fuselage forward Section

-- check for damage, cracks, or dents in the fuselage skin, and for secure closure of all fuselage forward section closures;

-- ascertain that the glasswork is clean and intact in the navigator's cabin light and the landing lights, and the fairing of the "ROZ-1" antenna and the KURS-MP-2 system antennas;

-- check for damage to the external-air thermometer



Фиг.I.9.МАРШРУТ ОСМОТРА
Figure 1.9 INSPECTION ROUTE

and pitot heads.

Forward Landing-Gear Strut and Housing

-- check for traces of oil leakage from hydraulic hoses, tubing, and connections;

-- check for oil leakage from beneath shock strut seals;

-- check shock-strut compression. There must be an obvious extension of these strut components, relative to the aircraft load (cf. scantling).

-- ascertain that the splined-joint disconnect unit is properly coupled;

-- check for oil seepage from beneath the turn-damper mechanism seals;

-- check tires for any damage precluding further use;

-- check for clogging of the drainhole beneath the limit switch in the splined-joint link, and inspect the wiring and limit switches on the strut and locks.

Fuselage Center Section Underside

-- check for traces of leakage in fuel and hydraulic systems lines and units;

-- check for skin surface damage and ascertain that all access covers are flush and securely fastened;

-- ascertain that the flasher-beacon-light glass is clean and intact;

-- be sure the fire-extinguisher dispersal nozzles are intact;

Left Main Landing-Gear Bogie

-- check whether the main-gear bogie housing rear doors are clamped shut;

-- check for traces of oil leakage from hydraulic system hoses and articulated connections on lines to the brake-mechanism cylinders;

-- check for oil leakage from beneath the shock-strut packing;

-- check for properly visible extension of the shock strut relative to the load on the aircraft (cf. scantling);

1-20/465L -- ascertain the presence of oil and hydraulic seals by the extension of the check plungers in the stabilizing shock struts;

NOTE: Do NOT check the pressure of the nitrogen in the stabilizing shock strut if the check plunger is in its normal position.

-- check the articulation of the landing-gear bogie, tipping mechanism, hydraulic-system fluid lines, and shock-strut suspension hinge lock, being sure they're not iced up;

-- check for tire-casing damage;

-- check whether the tire casings have shifted relative to the wheel drums. In case of excessive settling [softening] of the innertube, check their pressure by means of the gages in them;

-- check the wiring to the brake sensors and the landing-gear down-lock limit switch.

Left Wing Underside

-- check for traces of fuel leakage in wing-tank areas;

-- check for skin damage and be sure all access covers are flush-mounted and securely locked;

-- check for damage to ailerons and trimtabs, and be sure they are properly aligned;

-- check for damage to the NAS-1A high-frequency unit access cover;

-- check for damage to exterior antennas;

-- ascertain that the glass on the navigation lights and the static eliminators is clean and intact.

Fuselage Left Side

-- check for skin damage;

-- ascertain that the passenger cabin windows are clean and intact.

Left Engine Pod

check for skin damage and for traces of leakage from fuel or oil system components, lines, or connections.

Fuselage Tail Section

-- check for skin damage;

-- ascertain that the drogue chute bay doors are securely closed, which can be checked by means of check-ports in the doors;

-- ascertain that tail navigation lights are clean and intact.

Tail Control Surfaces

-- check for skin damage and be sure all access covers are flush and securely locked;

-- check for skin damage and proper alignment of the elevators, rudder, trimtabs, and stabilizer.

Fuselage Right Side

Inspect and check the aircraft fuselage right side in exactly the same procedure as the left side, and also:

-- check for oil leakage from beneath the centralized fuel filler access cover. Besides this, ascertain by means of the MV-250M pressure gage in the wing center section underside that the compressed-air pressure is at the proper level of 150 kg/cm^2.

1-21 Fuselage and Wing Upper Surfaces

-- check for damage to skin, passenger-cabin windows, and flasher-beacon glass fairing;

-- check for damage to ailerons and trimtabs.

Following exterior inspection, in compliance with the maintenance crew aircraft preflight preparation chart, be sure all traces of fuel have been removed from the draincocks.

(c) Checking the Passenger and Crew Cabins

6. Be sure all entry and luggage-compartment doors are properly secured, that their rubber seals are not damaged, that the locks operate reliably, that the emergency exits are closed and that the on-board OU fire extinguishers are sealed and in their designated places in the aircraft.

Check the cleanliness of the cabin and be sure it is cleared of all extraneous objects. Ascertain that all cabin windows are clean and intact. Be sure the PPNR-15 landing-gear extend-and-retract lever is in neutral position, and that the landing-gear emergency-extension handcrank is locked in lowered position.

7. Check oxygen reserves in integral and portable tanks by means of gages on the pilots' control panels and on the KP-21 instruments. If necessary, charge the tanks with oxygen up to the pressure levels indicated in the accompanying table, relative to ambient temperatures:

Table

t °C	-40	-30	-20	-10	0	10	20	30	40	45
p $\frac{kg}{cm^2}$	24	25	26	27	28	30	31	31	32	32

8. Sit in the Copilot's seat, adjust the seat and pedals to fit, and check the condition of the following:

-- all flight and navigational instruments;

-- the altimeter and UVPD-5K cabin-pressure differential gage, the pointer of which should rest at "0";

-- the URVK and URV-1500 air-mass flowmeter needles, which should indicate "0";

-- the TTsT-13 deicer thermometer needle, which should indicate the ambient temperature;

-- the TV-1 and TUE-48 ("heating and ventilating") thermometers of the TV-19 unit, which should indicate cabin air temperature; and

-- the radio control panels.

9. Be sure that all on-off switches and selector

switches on the upper electrical panel and pilots' consoles are in off position and that the engine-starting-panel cover is closed; then order the navigator to engage the on-board power supply.

1-22/465L 10. Check the illumination of your work area and the working order of the instruments, the flasher-beacon, and the navigation lights (with the help of ground-crew members).

11. Ascertain that oxygen masks are on hand and in good working condition.

12. Check the cabin decompression and overcompression warning signals.

13. Depress the "bulb check" button to check the condition of the bulbs in the warning light display panel.

14. Check the accuracy of the VD-20 altimeter barometric pressure reading scale against the airport barometer. A discrepancy of ±2 mm Hg is permissible. Adjustment of the altimeter scales on the aircraft is strictly prohibited.

15. Check communications with other crewmembers via the aircraft intercom system, and contact with the airport departure traffic control via the radio.

16. Check operation of the electrical trimtab actuating mechanisms by actuating them briefly, then setting them to neutral position as shown by the aileron and rudder trimtab indicator lights and the elevator trimtab mechanical indicator. Synchronize the aileron trimtabs if necessary.

Upon receipt of the aircraft from a repair plant, or following preventive-maintenance service at an aircraft maintanance base, the Copilot, joined on the flight deck by the Flight Engineer, should check alignment of the rudder and elevators, the ailerons, and the trimtabs to ascertain that they conform to the various control positions of the control colums, wheels, pedals, and trim-setting controls.

17. Upon completion of his assigned preflight equipment preparation, the Copilot reports to the Captain that the equipment is ready for the flight.

Aircraft Equipment Check by Navigator

1. Conduct a superficial examination of the cabin, the instruments, radio-navigational equipment, and navigator's equipment, making sure that:

-- the cabin glasswork and light filters are intact and in good working order;

-- the seats can be moved and swiveled without any hitches and will lock in any desired position, and that the seatbelts are intact;

-- the radar indicator can be traversed and locked without difficulty;

1-22a / 465 L -- the antenna equipment is in proper working order;

-- the control consoles and panels, the forward instrument panels, units, and instruments, the radio switches, and the protective housings are undamaged and properly secured;

-- the oxygen equipment and masks are in good working order;

-- the headphones and microphones are in working order;

-- the AC-panel primary fuses, fuse clamps, voltage adjustment screwdrivers for generator and converter, and the "in-flight" spare bulbs, fuses, and radio tubes are all in their appropriate places.

2. Be sure that the on-board circuitry switches for the generators, the ground power supply, and the storage batteries are all in "off" position (the individual switches for

each storage battery beneath the cover are switched on). At this point, the "instruments on battery power" light should be illuminated.

3. Be sure that all circuit breakers (AZS) are engaged and ask other crewmembers for confirmation that all electrically powered equipment is switched off.

1-23/465L 4. Set the voltmeter switch in the "AKK N° 1" or "AKK N° 2" position, whereupon at 22 amperes the battery voltage should be at least 24 volts. If the battery voltage is insufficient, replace the batteries.

NOTE: With the AZS (circuit breakers) on and the signal switches off, the engine indicators and circuit contacts take about 10 amperes current. Therefore, a couple of the "low-illumination" lights, drawing about 12 amps, should be switched on so as to check the batteries at the required 22-amp load.

5. Order the ground crew to switch on the aircraft ground-source power supply.

6. Take a voltmeter reading in the "RAP" [automatic start relay] position. It should read at least 28 volts.

NOTE: Where ground-source power is unavailable, be sure the brake booster pumps and service-power busbar are switched off to conserve the batteries, and advise the crew to avoid using instruments and other power units except in dire need; then check operation of the equipment after starting.

By turning on the "ground-source power" switch, the aircraft circuitry is connected to the [airfield] source, the "generator operating" light comes on and the "instruments on battery power" light goes out. Set the voltmeter switch to the "circuit" position.

7. Switch the PO-4500 converter selector switch sequentially from "operation" to "reserve" and ascertain by means of the VF-0.4-150 AC voltmeter that there is a voltage which is between 113-117 volts*. The reserve PO-4500 converter has a signal light which remains illuminated while it is oeprating.

8. Place the PO-4500 converter selector switch in the "neutral" position and turn on the navigator's windshield defroster by means of the switch on the navigator's instrument panel, whereupon the "reserve converter on" light should illuminate. Depress the [test] button to check the reserve converter voltage, which should be within 113-117 volts.

Switch off the navigator's windshield defroster.

9. Switch on the PT-1000TsS converters and check their operation by sequentially switching to "operation" and "reserve".

Be sure the operating PT-1000TsS converter is functioning by means of switching on and checking the operation of one of the 3-phase-current devices connected to the central circuitry.

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465L

Check operation of the reserve converter by placing the selector switch in the "reserve" position and observing whether the signal light illuminates on the navigator's electrical control panel.

Where necessary, check operation of the KPR-9 boxes as follows:

---

* Before switching on the PO-4500, use the pilots' intercom to ascertain that all IT-2 instruments are switched off.

-- place the PT-1000TsS converter selector switch in the "operation" position;

-- switch off the AZS-2 circuit breaker of the operating converter on the right hand panel, whereupon the "reserve converter operating" light should illuminate.

10. Switch on the AC ground-source power and check the ground-source voltage, which should be between 113-117 volts.

11. With both AC and DC ground power sources switched on:

-- ascertain operability of the RSBN-2S equipment;

-- check the control-panel radar-indicator instruments and the radar image quality on the display tube;

-- tune the first ARK-11 radiocompass to the DPRM [outer marker beacon]; tune the second one to the inner departure homing beacon [close-in homing beacon];

-- enter the takeoff-location latitude into the KS-8 course indicator system console;

-- switch on the course indicator system power;

-- five minutes after switching on the course indicator system power, set the operation mode switch to the "MK" magnetic course correction position and match it (by means of the quick-match button) to the primary and reserve gyros;

-- compare Navigator's course indicator reading with those of the Pilot and Copilot, neither of which should deviate from the Navigator's reading by more than ±2°;

-- check all course-indicator readings against the aircraft flight-line course reading;

-- at 12 minutes after switching on the course indicator system, check the "GPK" mode operation of the primary and reserve gyros;

1-24a / 465 L -- enter the initial data and check operation of the NAS-1A6 system.

-- check the VD-20 altimeter barometric reading against the airport barometer. The discrepancy should not exceed ±2 mm Hg. The altimeter scale must never be adjusted on the aircraft;

-- check operation of the SPU-7 intercom system by conversing with each crewmember, then listen to the control tower operation via the USW radio; check cabin and instrument illumination, and check operation of the external-air thermometer;

12. Synchronize timepieces at all crew stations.

13. Check availability of correction graphs for the altimeters, airspeed indicators, and the KI-13 magnetic compass.

14. Check the condition of the silica gel in the ROZ-1 moisture absorber.

15. Upon completion of the preflight preparation and checkout assignment of the Navigator, he reports to the Captain that the aircraft is in flight-ready condition.

Aircraft Checkout By Steward(ess)

1. Inspect the passenger cabins, making sure they are clean and clear of extraneous items; that the upholstry, curtains, seats, and luggage racks are intact; that the portable oxygen equipment and masks are in complete order; that there

are coat hangers and portable baby cribs available, and that medicines are stored in the crew quarters medicine chests.

1-25 See that teh carpets secured in place by their rubber molding and unwrinkled. See that clean ashtrays and reading materials are available, and that all seatbelts are intact.

2. Check whether the seat pillowcases have been changed.

3. Check whether the aircraft water supply has been replenished.

4. Inspect the galley and make sure that it is clean and clear of extraneous items, and that all equipment is intact.

5. Upon connecting the aircraft circuitry to the ground-source power supply, check the illumination lights in the passenger cabins, passageways, rear luggage compartment, and restrooms, and check the steward service-call signal.

CAUTION: When the engines are shut down and ground-source power is NOT connected, the steward(ess) may turn on only the service lights, threshold lights, and call signal.

6. Check operation of the SGU-15 loudspeaker system and the telephone intercom connecting the stewards with the other crewmembers.

7. Inspect the wardrobe*, passageways, and service compartment, making sure all is in order, clean, and clear of extraneous items.

8. Inspect the restrooms, making sure they are clean

* Additional units may be installed at cost of reduction in seating space.

and clear of extraneous items; that the toilet bowl is in proper working order, with paper and water available; that the waste receptacles and washbowls are in proper working order, with soap and towels available. Check operation of the toilet bowl pumps.

9. Take aboard the aircraft the containers of foodstuffs, clean dishes, and electric steam tables.

10. During darkness, with the aircraft connected to the ground-source power supply, switch on the passenger cabin and galley illumination. If not connected to the ground-source power, turn on only the service lights in the cabins and passageways.

11. While passengers are boarding the aircraft, switch on the seat numbers and help place the passengers' coats in the wardrobe.

12. Check the fasteners on the containers and steam tables in the galley and be sure they are properly secured. Upon completion of this inspection, report to the Captain that the equipment is flight ready.

The Captain's Checklist

1. The Captain accepts the readiness reports from the Copilot, Navigator, and Steward(ess), and then personally inspects the aircraft exterior and cabin interior to the same extent and in the same sequence as outlined for the Copilot.

2. Occupy the Captain's seat and check its adjustment

and condition, unlock the controls, and adjust the seat and pedals to proper fit; then:

1-26 -- inspect all instruments to see that none has been damaged;

-- make sure the airspeed-indicator and altimeter correction charts are available in place;

-- ascertain that the side vent traverses readily and closes tightly;

-- check the ease and smoothness with which the emergency brakes can be applied;

-- be sure that the switches for the IT-2 front-wheel steering-control and brake-system hydraulic pumps are in the "off" position, and that the automatic [anti-skid] brake control is switched on;

-- compare the readings of the VD-20 altimeter barometric pressure scale with those of the airport barometer. The discrepancy allowance is ±2 mm Hg. The altimeter scale must NEVER be adjusted on the aircraft.

-- check the emergency brake-system reservoir-pressure reading (210 kg/cm^2);

-- check the oxygen system instruments to be sure the system is charged, and be sure all masks are in place.

3. Check the SETS-470 fuel gage to determine how much fuel has been loaded aboard, and set the RTSV-10-8 fuel-consumption indicator to show the actual amount of fuel in the plane's tanks.

4. Check the working order of the AU ASP-3K automatic

signal device by depressing the button on the electrical control panel.

5. Check the condition of the PPD-1V pitot heater.

6. Switch on the power to the SOM-64 and make sure its signal light indicates proper operation, then set in the required code.

7. Check the aircraft control systems with the engines operating (see Section 2, subsection 10).

8. Check operation of USW Radioset N°1 by establishing contact with the airport departure control tower.

9. Check operation of the aircraft intercom system by contacting each of the crewmembers.

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Flight Engineer's Preflight Inspection and Preparations

Before engaging in his preflight preparations, the Flight Engineer should check for the following:

-- aircraft registration certificate and airworthiness certificate, sealed medicine kit, aircraft fireaxe, drinking water and other inventory, and the Civil Air Fleet manual for the specific flight.

Check the in-flight maintenance checklist for conformity of performance. Having ascertained that all problems reported by the previous flight crew have been corrected, the Flight Engineer accepts the aircraft from the parking duty attendant.

Preliminary Operations

1. Ascertain that the fire-fighting equipment is near the aircraft, wheelchocks are in place under the main landing gear, and the aircraft is properly grounded.

2. Be sure all hoods and covers, except the engine intake covers, have been removed from the aircraft.

3. Besides the above, ascertain that:

(a) fuel tanks are filled to trip specifications;

(b) engine oil tanks are filled (20 liters each);

(c) hydraulic system tanks are properly filled (the primary system tank should contain 25 liters when both primary system accumulators are charged, the landing gear is extended, and the spoilers are retracted);

The brake system should contain 16.5 liters with the master cylinders charged and the brakes applied;

The automatic [control] system should contain 3.8 liters[)];

(d) the compressed-air system should show a pressure of 150 kg/cm^2;

(e) the aircraft oxygen system and portable tanks should be properly charged;

(f) the pressure gage on the OS-8M fire extinguishers should show the proper reading;

(g) the aircraft water system should be properly filled (during winter, with water heated to +60°C) and the toilet solution replenished (this solution should be heated to +35°C during winter);

(h) in compliance with the preflight preparation chart, be certain that all traces of fuel sediment are cleared away.

4. When temperatures exceed +25°C in the cabin interior, it should be cooled to temperatures on the order of +20°C, on condition that the total difference between exterior and interior temperatures not exceed 10-12°C.

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Before cooling the cabin, the Flight Engineer should be sure the crew-cabin cool air feed is open and he should open all crew-cabin vents and the door.

5. When the interior temperature of the cabin falls below +5°C, it should be heated up to temperatures of some 15-20°C.

6. The following should be ascertained during winter:

(a) the degree to which ice, snow, etc. have been cleared from aircraft surfaces, crew- and passenger-cabin windows, engine intakes, the control and suspension elements of ailerons, elevators, rudders, flaps, slats, spoilers, trim-tabs, and bellyflaps, and from exterior antennas, the glass-work in flasher-beacon, navigation, and landing lights, and the intakes of the pitot head and exterior-air thermometers.

Aircraft Inspection and Checkout
(conducted in a prescribed manner)

Fuselage Forward Section

Ascertain:

-- that there is no skin damage and no scratches or dents, and be sure all forward fuselage closures are secured;

-- that the glasswork of the navigator's compartment, the landing lights, and the radome are clean and intact;

-- that the pitot-head and outside-air thermometer intakes are undamaged.

Forward Strut and Landing-Gear Bay

Ascertain:

-- that hydraulic-system hoses, tubing, and connections bear no traces of oil leakage;

-- that no fluid is leaking from beneath the shock strut seal;

-- proper compression of the shock strut (cf. scantling). The visible height of the shock strut working part should be within the limits indicated on the scantling;

-- that the splined-joint removable unit is connected;

-- that no fluid is leaking from beneath the steering-damper mechanism seal;

-- that the tires are not damaged sufficiently to preclude their further use;

-- to what extent the tires have settled (cf. scantling)

-- that the splined-joint drag-link limit-switch drain-hole is not plugged, and inspect the strut and lock limit-switch wiring harness;

-- that the observation windowglass in the flight-deck floor is clean.

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Fuselage Center Section

Ascertain:

-- whether there is any leakage from fuel system tubing and connections or from hydraulic system components;

-- that there is no skin damage and that all closures are flush mounted and securely latched;

-- that the flasher-beacon glass is intact and clean.

Left Main Landing-Gear Strut

Ascertain:

-- that the wheelwell rear doors are latched shut;

-- that hydraulic hoses, articulated connections, and tubing leading to the brake cylinders bear no leakage traces;

-- that no oil is leaking from beneath the shock-strut seal;

-- proper compression of the shock strut, the visible height of the shock-strut working part should depend on the load (cf. scantling);

-- to what extent the tires have settled (cf. scantling);

-- that there is packing grease in evidence upon withdrawal of the plunger from the end of the stabilizer shock-strut box.

NOTE: Do NOT check the nitrogen pressure in the stabilizing shock strut if the plunger is in normal position.

-- the condition of the bogie articulation units, the tipping mechanism, the hydraulic system connections, and the shock-strut lock loop;

-- that the tires are not damaged or displaced on the wheeldrums;

-- the condition of the limit-switch and brake wiring harnesses.

Left Wing Underside

Ascertain:

-- that there is no fuel leakage from integral wingtanks;

-- that there is no skin damage and that all closures are properly flush mounted and securely latched;

-- that the ailerons and trimtabs are properly aligned and undamaged;

-- that the anti-static device and navigation-light glasswork is intact and clean.

Fuselage Left Side

Ascertain:

-- that the skin is undamaged;

-- that the passenger cabin windows are intact and clean.

Left Engine Pod

Ascertain:

-- that the skin is undamaged and the areas occupied by fuel- and oil-system components show no traces of leakage;

-- that the engine airduct interior is clear of all extraneous objects and dirt;

1-26d
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-- that the jet exhaust nozzle is clear of extraneous objects;

-- that the first-stage rotor turns freely, turning it manually by means of the turbine blades;

-- that the cowling is securely latched shut;

-- that the oil-tank filler neck is securely closed;

Fuselage Tail Section

Ascertain:

-- that the skin is undamaged and the drogue-chute doors are securely latched shut;

-- that the drogue chute ring hooks are closed;

-- that the tailend navigation light glasswork is intact and clean.

Tail Empennage

Ascertain:

-- that the skin is undamaged and all closures are flush and securely latched in place;

-- that elevators, rudder, trimtabs, and stabilizer are undamaged and properly aligned.

[Aircraft] Right Side

Perform this inspection exactly as was done on the left side of the aircraft, further checking for fuel leakage from beneath the central fuel intake cover.

Fuselage and Wing Topsides

Ascertain:

-- that there has been no damage to skin, passenger-cabin windows, or flasher-beacon glasswork;

-- that the fuel tank filler covers are securely closed;

-- that no fuel is leaking along the wingtank removable panel.

Passenger Cabin, Baggage Compartments & Lavatories

Inspect the passenger cabin, baggage compartments, and lavatories, and ascertain that:

-- all seats are clean, clear of extraneous objects, and supplied with listed replaceable personal accommodations;

-- all windowglass is intact and clean, and the emergency exits are closed;

-- the entry and baggage doors are undamaged, their rubber seals intact, and their latches functioning properly;

-- the portable oxygen equipment kits are in place and complete, and that the oxygen tanks are fully charged;

-- all on-board fire extinguishers are properly sealed and in place;

-- the water-tank cock is closed;

-- the requisite number of carpets cover the floor.

1-26e
465 L The Crew Compartment

Be sure the landing-gear control knob is in neutral position and the emergency landing-gear-extension valve handle is secured in lowered position.

Ascertain:

-- that the cabin is clean and clear of extraneous items

-- that the windowglass is intact and clean;

-- that the side vents move freely and close securely, and that the seats are properly adjusted to fit;

-- that the oxygen equipment is in proper working order, and the masks are ready at hand;

-- that the floors are properly carpeted;

-- that the front-wheel steering-control switch is in the "off" position;

-- that all instruments are undamaged and the instrument panels securely fastened.

7. Before switching on the electric power source, carefully ascertain:

-- that all switches and selector switches on the upper electrical control panel, the Pilot's and Copilot's control panels, and the Navigator's and Steward(ess)'s electrical panels are in "off" position;

-- that the automatic circuit breakers on the AZS panel are switched on;

-- that the starter cover is closed;

-- that, prior to switching onto ground-source power, the battery voltage is checked under a 23-ampere load.

8. After checking the SETS-470 fuel gage to determine the amount of fuel loaded, the RTSV-10-8 fuel flowmeter needle must be set to indicate the actual amount of fuel in the tanks, and the densitometer set to indicate the type of fuel loaded.

Then check operation of the tank-booster and transfer pumps by means of the instrument panel indicator lights, and operation of the fire-extinguisher cock and the cross-feed cocks.

9. Check the working order of the fire-protection system, which necessitates the following:

-- switch off the AZS in the extinguisher tank control circuit;

-- be sure the fire-protection system stopcock circuit breakers are switched on;

-- switch on the fire-protection system panel main switch;

-- depress the test button to check proper operation of the indicator lights;

-- sequentially depress the fire-alarm illuminated buttons, whereupon they should light up, indicating that the stopcock solenoid has opened and the generator blower baffles are closed;

1-26f / 465 L -- turn the main switch on and then off again; the illuminated buttons should go out;

-- switch on the tank control circuit breaker system and be sure the white lights illuminate.

10. From both the Pilot's and Copilot's positions, check the ease of movement of the engine throttle levers, and the proper function of the detents on the Pilot's control levers.

11. Upon accepting the aircraft from a repair plant, or following maintenance at an aircraft maintenance base (ATB), the Flight Engineer, with the help of the Copilot at the flight-deck controls, should check the alignment of the elevators, rudder, ailerons, and trimtabs at all positions of the control column, wheel, pedals, and trim controls.

12. In compliance with maintenance regulations, the Flight Engineer shall be accompanied, during preflight service

testing and checking of the aircraft, by the responsible specialists of the ATB as the engines are started and checked out.

Final Operations

-- completion of maintenance records;

-- acceptance of aircraft from maintenance crew;

-- before towing the aircraft, be sure the towbar is securely attached to both aircraft and tractor;

-- be sure all hoods, covers, and airport equipment have been removed from the aircraft;

-- after passengers have boarded and luggage is loaded, be sure the freight and luggage are securely fastened and then close the aft luggage compartment door;

-- after towing the aircraft to the pre-start area, make sure the entry door and luggage compartment doors are closed securely;

-- report ready to start engines.

*** End of Section 1 ***

SECTION 2

EQUIPMENT OPERATION

AND

FLYING THE AIRCRAFT

2-7

Chapter One

AIRCRAFT EQUIPMENT OPERATION

1. THE POWER PLANT

The D-30 Engine

The D-30 engine (Figure 2.1) is a two-spool, two-rotor turbofan engine with a two-stage compressor.

The compressor is an axial-flow type. The first section of the compressor is four-stage and the second section is ten-stage.

To facilitate stable operation of the compressor at low rpm, the second section of the compressor is equipped with an air bypass after the fourth and fifth stages in the outer engine spool as well as an air inlet guide apparatus with movable vanes.

The engine turbine is an axial-flow, reactive, four-stage turbine consisting of two turbine sections.

The engine is equipped with an air bleed system for pressurizing the cabins, deicing systems for the aircraft and engine, as well as fire-extinguishing signal systems in the nacelles and engines.

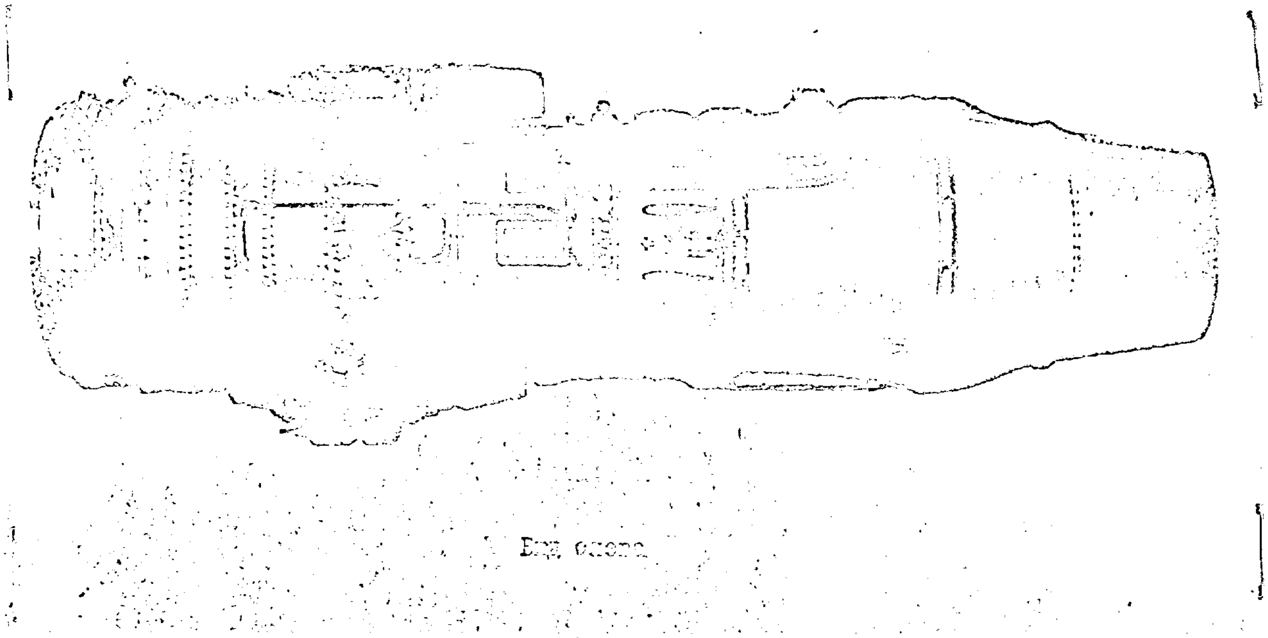
The SPZ-30 Engine Starter System

An SPZ-30 starter system is installed in the aircraft to start the D-30 engines.

Each engine is started by two simultaneously operating STG-12TMO-1000 starter generators, each rated at 12 kw, which are powered by an airport power source of 24-48 v or the two on-board 12SAM-55 storage batteries.

Engine starting is automatic and is initiated by a single APD-19BD

[2-8]



The D-30 Engine

(view from left side)

automatic panel. The starter panel contains a timing mechanism and nine relays designed for the sequential activation of the starting system components as prescribed by the timing mechanism.

Engine Operation Monitoring Instruments

Engine operation is monitored with the aid of the following instruments:

-- tachometers;

-- IT-2 engine exhaust gas temperature gages;

-- EMI-3RTI three-needle indicators (fuel pressure before injection, and oil pressure and temperature);

-- DIM-4T pressure gages (fuel pressure at engine intake);

-- RT3V-10-8 fuel flow meters;

-- IV-200Yc vibration monitoring apparatus (indicator and signal lamp);

-- signal lamp for indicating presence of "metal chips in oil";

-- signal lamp "VNA-10°" indicating position of vanes;

-- signal lamp indicating engine icing and automatic activation of engine deicing systems;

-- regulators PRT-35 of maximum exhaust gas temperature.

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Preparing the D-30 Engines for Flight

Preparation for starting, starting and testing the engines are the duties of the aircraft commander or the engineer servicing the aircraft; in such cases the navigator's position must be occupied by a crew member (or someone else responsible for preparing and monitoring the operation of the equipment in the navigator's cabin).

As a rule, the engines are started from the airport electrical power supply.

Before starting the engines make sure that:

-- communications with the controller on the ground over the aircraft intercom system are reliable and the ground technicians are ready for starting the engines (communications with the technician on the ground over the aircraft intercom must be maintained for the entire time from preparation for starting to taxiing out);

-- step-ladders and other equipment on either side of the aircraft are removed to a distance which will ensure safety in starting and testing the engines; at the same time, service personnel must be no closer than 10 meters in front of the air intake and 50 meters from the nozzle exit in the exhaust zone;

-- all covers are removed;

-- the doors and cargo hatches are closed;

-- the wheels are locked by the parking brake and chocks are placed under the wheels.

Before the engines are started the copilot must:

-- place the switches labeled "Cabin Pressurization," "Automatic Equipment Power Supply," "TTh, VVR Ventilation," "Cabin Heating," "Ventilation at Low Altitudes" and "Ventilation on Ground" in the position corresponding to a closed valve position; make sure that the wing and tail-fin heating system is off;

-- check the operation of the system which signals loss of pressure and overpressurization of the cabin by pressing the appropriate buttons.

a) Preparing the engines for starting when the aircraft's electrical system is connected to the airport electrical power source:

1) Make sure that all circuit breakers are on;

2) Check the charge of the storage batteries at a load of 22 a; the voltage must be at least 24 v;

3) Connect the airport power source; the voltage must be 22.5 v;

4) Turn on the PO-500 converter and make sure that it is operating; turn on the IT-2 instrument;

5) Make sure that the starter-generator switches are off;

2-10 465L 6) Place the "Fuel Gage" switches in the "On" position;

8) [sic] Place the fire-extinguishing system switch in the "On" position. Lighting of the white signal lamps indicates proper operation of the electrical circuits for the fire-extinguishing cartridges of the 1st, 2nd and 3rd sequence of the main system and the 1st and 2nd sequence of the fire-extinguishing system within the engines;

9) Check the condition of the button-lamps and the "Fire Left-Right" display by pressing the lamp test button of the fire signalling system;

10) Press the "lamp monitoring" button on the "dangerous operating conditions" display and check the condition of the signal lamps marked "Excessive Vibration," "VNA-10°," "Metal Chips in Oil," "PRT Failure," "APD Operating" and "Start Interrupted;"

11) Place the automatic fuel consumption control switches in the engaged position;

12) Place the "Pumping" switch in the "Automatic" position;

13) Place the fuel pump switches labeled "Engine Supply" in the engaged position;

14) Place the fire valve switch in the "Open" position; before opening the valve check the tightness of the seal (in the absence of pressure with the pumps operating). The green light should go on when the valve is fully open;

15) Check the operation of all fuel pumps (green lights should be on);

16) Unlock the rudder;

17) Check the ease of movement of the engine controls, the operation of the catches, and place the control levers in the "arrested" position;

18) Place the "IV-200" switch in the engaged position and check the condition of the apparatus.

b) Preparing the engines for starting when power is supplied by the on-board storage batteries:

-- Carry out all steps listed under paragraph a) above, with the exception of points 1, 6, 11, 12, 15, 18, 13;

-- Place the pumping switch in the "Manual" position;

-- Switch on one of the "Engine Supply" pump switches.

Starting the Engines

The following sequence should be followed to start the engines:

-- open the cover of the starter panel;

-- turn on the main switch;

-- place the "Ground-Air" switch in the "Ground" position;

-- place the "Engine PRT" switches in the engaged position;

-- place the "PRT-35" operating mode switches in the "Operating" position;

-- place the "Start-Motor" switch in the "Start" position;

11 -- make sure that the fuel pressure at the inlet to the NR-30 is within limits of 0.8 to 1.0 kg/cm^2;

-- set the aircraft parking brake;

-- give the command "Clear Engines" and, having received the response "Engines Are Clear" from the ground, press the "Start" button for one to two seconds and simultaneously start the stop watch; at this time the signal lamp labeled "APD Operating" should come on.

After pressing the "Start" button, after the rotor of the second stage of the compressor has reached an rpm of 7 - 8.5%, move the engine control lever to the "Idle" position.

The process involved in moving to idling speed is as follows:

-- at an engine rpm of N = 37-40% (4,500 ± 200 rpm), or within 45 to 50 seconds after pressing the button, the starter-generators should disengage;

-- as the engine speed builds up the fuel pressure in front of the injector increases smoothly (the first section of the injector is operating), and when the pressure reaches 12 kg/cm^2 the second section of the injector begins operating; during this time the fuel pressure drops and then builds up as engine rpm increases. The engine should automatically switch to the idling mode within a time period not exceeding 120 seconds according to the graph shown in Figure 2.2.

WARNING: 1. When starting the engine it is forbidden to make manual corrections of fuel consumption by moving the engine control lever.

2. The engine starting procedure may be interrupted by placing the control lever in the "Stop" position and pressing the "Interrupt Start" button in the following cases:

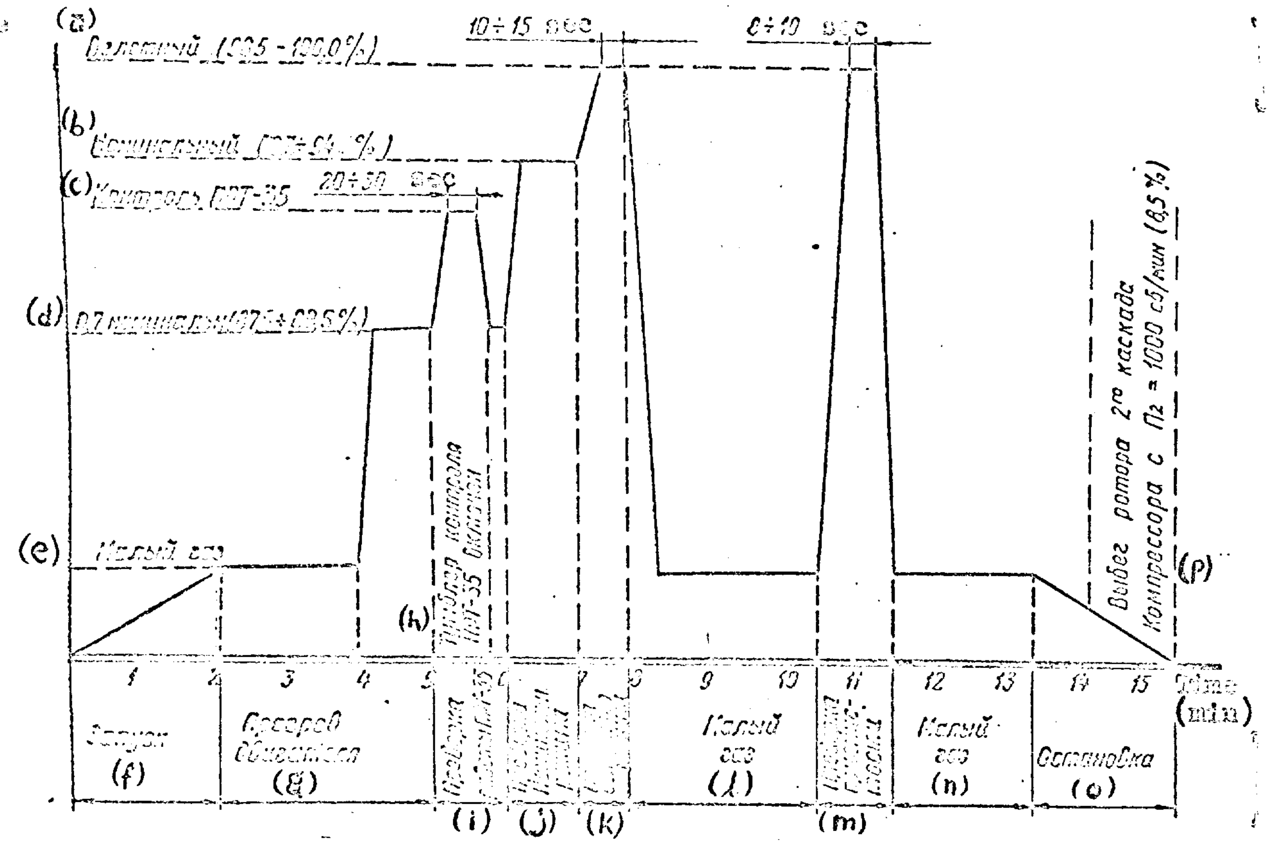

Figure 2.2. Engine Warm-Up And Test Chart

(a) Flight (98.5 - 100.0%)
(b) Nominal (92.5 - 94%)
(c) Monitor PRT-35
(d) 0.7 nominal (87 - 88.5%)
(e) Idle
(f) Start
(g) Engine warm-up
(h) PRT-35 monitoring switch "On"
(i) Check operation of PRT-35
(j) Check nominal mode
(k) Check flight mode
(l) Idle
(m) Check acceleration
(n) Idle
(o) Stop
(p) Run-down of rotor of compressor second stage from N2 = 1,000 rpm (8.5%)

-- if the starter-generator did not disengage at an engine speed of N = 37 - 40% or within 45 to 50 seconds after the "Start" button was pressed;

-- if there is no oil pressure indicated at the engine intake;

-- if the temperature of the gases behind the turbine is 620°C and did not drop for a period of four seconds, or if there is a tendency for temperature build-up;

-- if the build-up in engine rpm terminates ("hovering" of engine revolutions);

-- an absence of oil pressure build-up at the engine intake;

-- the indicator lamp "metal chips in oil" goes on;

-- if the electrical power source voltage as read on the aircraft voltmeter is less than 21 volts;

-- arbitrary disengagement of the starter-generator (the "Interrupt Start" lamp goes on);

-- the detection of any other engine malfunctions.

3. After two or three unsuccessful attempts to start the engine, when fuel has been supplied to the engine but ignition has not occurred, engine motoring must be carried out [to expel the unused fuel].

2-13 Engine motoring is carried out in the same sequence as when starting the engine, with the exception that the control lever is placed in the "Stop" position and the "Start-Motor" switch is placed in the "Motor" position.

During engine motoring the engine rpm should be maintained at 7 - 10% (800 - 1,200 rpm) and the oil pressure at the engine intake should be at least 0.2 kg/cm^2. Motoring should be carried out for 30 to 36 seconds.

WARNING: 1. An attempt to restart the engine should be made only after the second stage of the compressor has come to a complete stop and after the cause of the previous failure to start has been located and corrected.

2. Wait five minutes between each attempt to start the engine and 30 minutes after five attempts have been made, marking time from the moment the "Start" button is pressed.

3. Engine motoring should be carried out before starting the engine if the aircraft has been standing for more than five days.

Once the engine has started place the main starter switch in the "Off" position, place the "Ground-Air" switch in the "Air" position and close the cover on the starter panel.

Warming Up And Testing the Engines

5. [sic] The operation of the engines should be checked in accordance with the engine warm-up and test chart shown in Figure 2.2.

6. After the engines have started permit them to warm up at idling speed for a period of two minutes (no less). Engine operating parameters in the idling mode with $P = 760$ mm Hg and $t_{(outside\ air)} = +15^{\circ}$ C should be as follows:

-- idling rpm 61 - 62.5% (7,200 ± 100 rpm);

-- oil pressure 2.5 kg/cm^2 (no less);

-- gas temperature behind turbine 360° C (no more);

-- fuel pressure before injectors 25 kg/cm^2.

7. The idling rpm change with respect to atmospheric conditions in accordance with the chart shown in Figure 2.3.

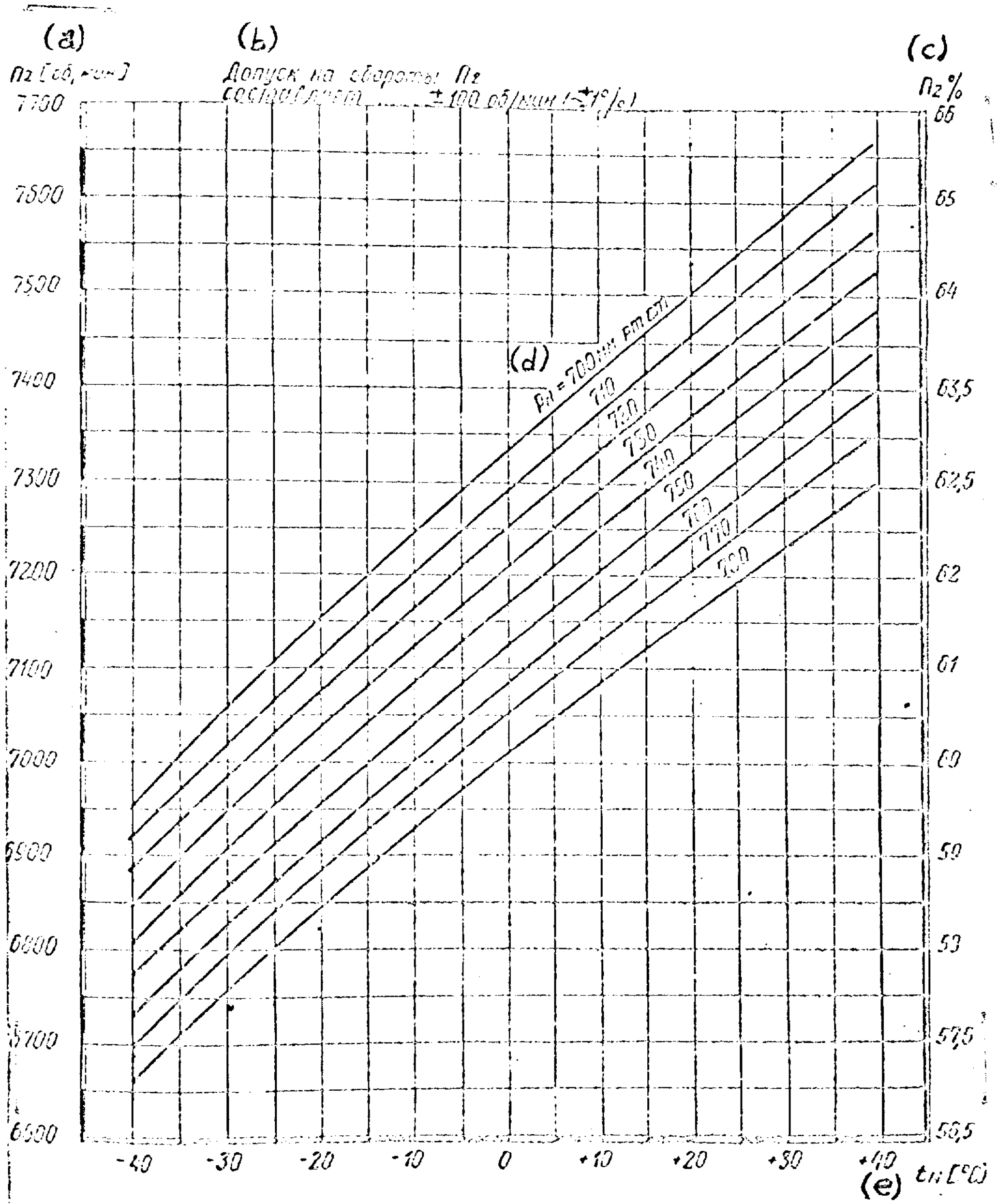

Figure 2.3. Change in RPM of Rotor of Compressor Second Stage (With Engine Operating in Idling Mode on Ground) With Respect to t_n and P_n (Outside Air Temperature and Pressure).

(a) N2 (rpm) -- 2nd stage rotor speed
(b) N2 allowance is ±100 rpm (~ ±1%)
(c) N2 (%)
(d) P_n = 700 mm Hg
(e) t_n (°C)

NOTE: 1. A final check of the iding rpm is made after testing the engine in all operating modes.

2. Check the operation of the hydraulic pump after starting one engine. The operation of the hydraulic pump of the second engine should be checked after the first engine is cut off.

2-15 8. Move the control lever to 87.0 - 88.5% (0.7 rated power) and run the engine in this mode for at least one minute. At 79.5 - 81.5% (9,400 ± 100 rpm) check the closing of the air bypass valves from the fourth and fifth stages of the compressor. A short-term build-up of fuel pressure before pump NR-30 indicates that the valves are closing. At this same engine speed check the signal lamp to make sure that the VNA vanes are repositioned from an angle of -10° to 0°.

9. Make sure that the engine and the IV-200Ye apparatus (vibration monitor) are operating properly. Vibration rate according to the instrument should not exceed 50 mm/second.

As the vibration rate increases to 50 ± 10 mm/second, the signal lamp marked "Excessive Vibration" goes on. When the vibration rate exceeds 50 mm/second, reduce the operating mode of the engine to idling speed and stop the engine once it has cooled down. The question of continuing to operate the engine should be solved jointly with a representative of the manufacturing plant.

10. Check the operation of the post-turbine gas temperature limiter (PRT-35) by allowing the engine to warm up at 87 - 88.5% (0.7 rated power), moving the PRT mode switch to the "Monitor" position and smoothly moving the engine control lever to the "Maximum Mode" position. The temperature of the gases behind the turbine should become equal to the temperature

established by the URT-19A-2T controller minus 110 ± 10° C. After operating at the monitoring point for a period of 20 to 30 seconds, reduce the engine rpm to 87 - 88.5%, move the PRT mode switch to the "Operate" position and establish a rated power mode of 92.5 - 94%. The time required for disengagement of the PRT-35 and changeover to the rated mode is 10 to 20 seconds.

11. After running the engine in the rated power mode for a period of one minute, set the engine control lever in the "Maximum Mode" position and run the engine for 10 to 15 seconds, after which smoothly reduce the engine rpm to idling speed. At an engine rpm of 77 - 79.0% (9,100 ± 100 rpm) check the opening of the air bypass valves from the fourth and fifth stages of the compressor. A temporary drop in fuel pressure in front of the injectors to 4 - 6 kg/cm^2 indicates that the valves have opened. Simultaneously, at the same engine operating rpm, check the signal lamp which registers repositioning of the VNA vanes from an angle of 0° to an angle of -10°.

12. When the engine is operating in the idling, rated and flight modes, its operating parameters must correspond to those shown in table No 4 of Section I and to the charts shown in Figures 2.3, 2.4 and 2.5.

NOTE: 1. Interrupted operation of the engine is permissible in the flight mode for a period of five minutes with subsequent interruptions of at least five minutes, during which time the engine must be operated in a mode not exceeding the rated power mode.

2. When running the engine up to the flight mode with the PRT-35 system disengaged, a sudden temporary rise in the post-turbine gas temperature to 630° C may be experienced.

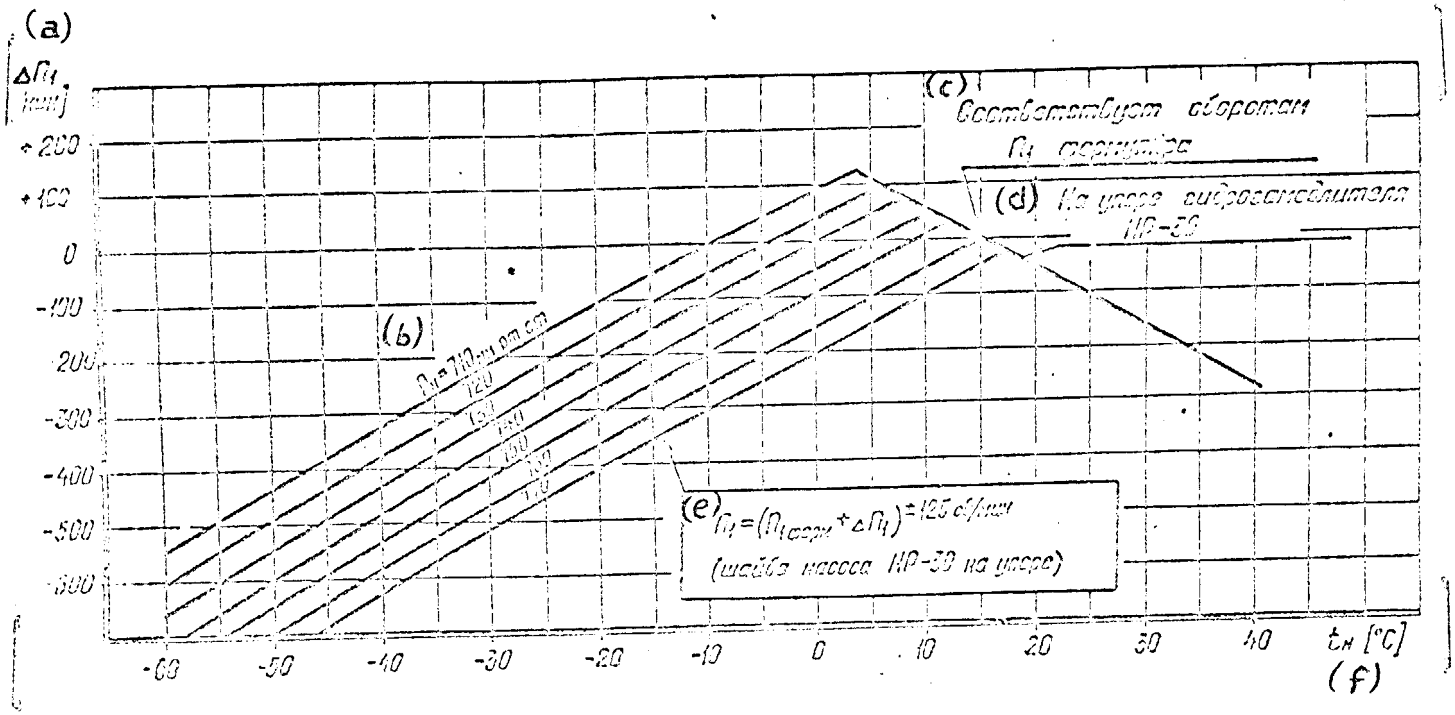

Figure 2.4. Change in RPM of Rotor of Compressor First Stage (With Engine Operating in Flight Mode on Ground) With Respect to Atmospheric Conditions.

(a) ΔN1 (rpm) -- 1st stage rotor speed
(b) P_n = 710 mm Hg
(c) Corresponds to engine log book speed of N1
(d) At hydraulic restrainer stop of fuel pump NR-30
(e) N1 = (N1 $_{log}$ + ΔN1) ± 125 rpm (washer of pump NR-30 against stop)
(f) t_n (°C)

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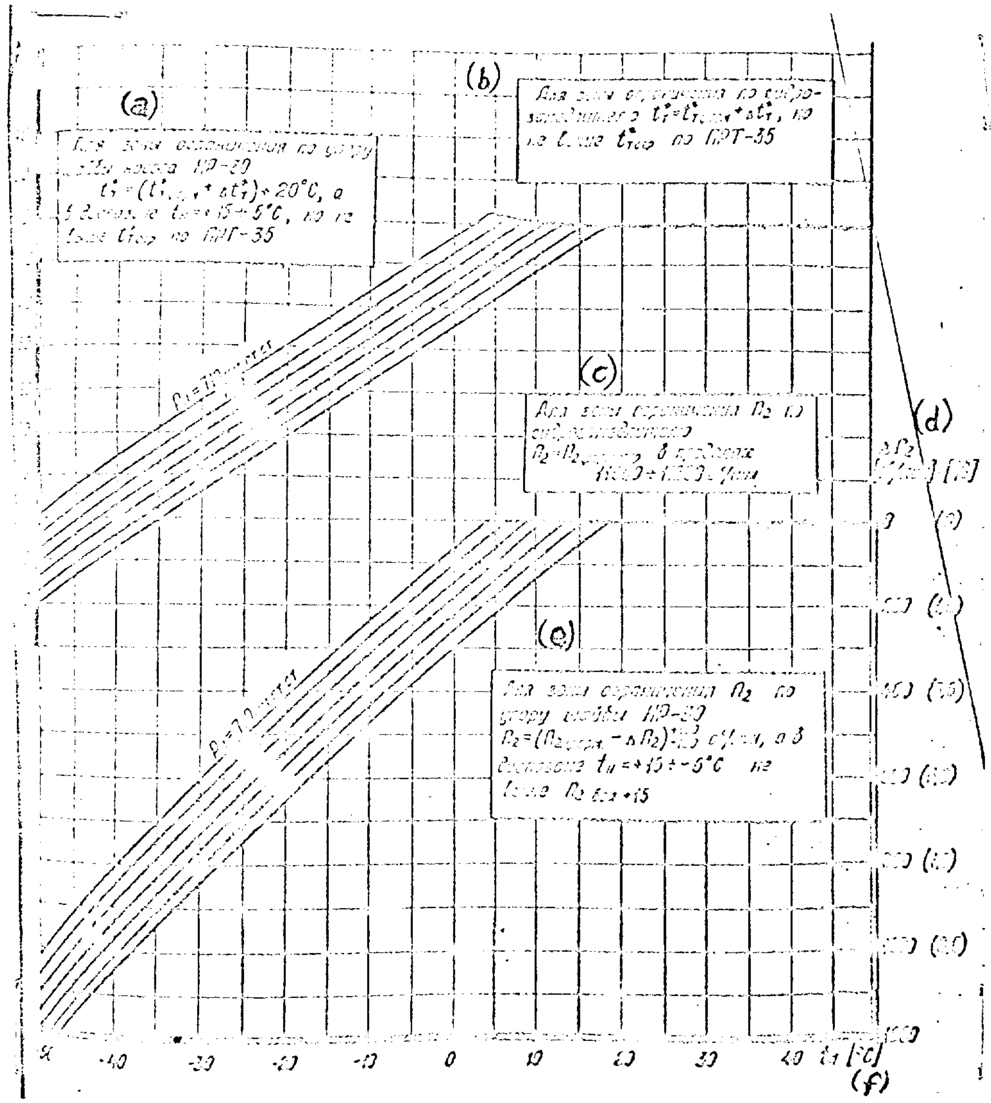

Figure 2.5. Change in Maximum Permissible Post-Turbine Gas Temperature and Rotor Speed of Compressor Second Stage With Respect to Atmospheric Conditions With Engine Operating in Flight Mode on the Ground.

(a) For the limiting zone with respect to the washer stop of pump NR-30, $t^*_T = (t^*_{T\,log} + \Delta t^*_T) + 20^\circ$ C, while in the range $t_n = +15$-5° C, not greater than $t^*_{T\,lim}$ according to PRT-35.

(b) For the limiting zone with respect to hydraulic restrainer, $t^*_T = t^*_{T\,log} + \Delta t^*_T$ but not greater than $t^*_{T\,lim}$ according to PRT-35.

(c) For the limiting zone of N2 with respect to hydraulic restrainer, $N2 = N2_{log}$ within limits of 11,500-11,650 rpm.

(d) $\Delta N2$, (rpm) and (%).

(e) For limiting zone of N2 with respect to washer stop, $N2 = (N2_{log} - \Delta N2)^{+100}_{-150}$ rpm, while in range $t_n = +15$--5° C, not greater than $N2_{flight} + 15$.

(f) t_n (°C).

18/465L 13. Check the acceleration characteristics of the engine. Move the engine control lever in 1 to 1.5 seconds from the "Idle" position to the "Maximum Mode" position. The time between beginning of movement of the engine control lever and the point at which the engine reaches an rpm of approximately 1.5% (180 rpm) below the flight mode rpm should be no more than 15 seconds and no less than 10 seconds. Run the engine in the flight mode for 8 to 10 seconds and, in one to 1.5 seconds, move the control lever to the "Idle" position. In all modes during advance and retardation of the throttle the engine should operate normally without vibration and engine detonations. The engine should be run at idling speed for at least two minutes before testing its acceleration characteristics.

NOTE: 1. In connection with the necessity for limiting maximum fuel consumption during operation of the engine in the flight mode while testing acceleration, when the ambient temperature is below +15° C the engine rpm should be computed for the given temperature of the ambient medium.

2. When checking the flight mode while air is being diverted to the deicing systems of the air intake and the engine, as well as during a rapid acceleration from idling speed to the flight mode, a temporary increase in the temperature of the gas exiting the turbine may be noticed but this should not be greater than the limiting temperature of the PRT-35 device. At negative ambient temperatures this increase in gas temperature may reach 20° C above the permissible value shown in the chart in Figure 2.5, but it should not exceed the limiting temperature of the PRT-35.

3. If after starting the engine the aircraft was taxied with the

engine operating at 87.0 - 88.5%, then it will not be necessary to run the engine in this same mode before accelerating to the flight mode.

4. When checking engine operation before flight as well as when monitoring engine parameters in flight (engine rpm, gas temperature after the turbine, oil pressure), the parameters in all flight modes must be within the limits indicated in basic data table No 4 (section 1). In this connection it should be remembered that on the ground, when the ambient air temperature is below +15° C, the rotor speed of the second compressor section will drop approximately 1.5 to 2% (in the flight mode) and the post-turbine gas temperature will drop approximately 20 to 25° C for every 10-degree drop in ambient air temperature (beginning at +15° C). Where the parameters vary from the basic norms they should be regulated in accordance with the instructions.

WARNING: 1. It is forbidden to activate the wing and rudder deicing system and the cabin pressurization system on the ground and in flight when the engines are operating below 95%.

2. The engine air inlet and engine deicing systems may be operated for a period not exceeding two minutes when the engines are operating below 95% on the ground and in flight up to an altitude of 2,000 meters.

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Stopping the Engines

14. Allow the engine to cool down in the idling mode for a period of at least two minutes and switch off the starter-generators (if the generators are not switched off before the engines are stopped, the EMR-400T [?] will knock and its service life will be shortened.)

15. Move the engine control lever to the "Stop" position.

16. Measure the "run-down" time of the compressor rotors from 8.5% (1,000 rpm). The "run-down" time should be:

-- at least 90 seconds for the rotor of the first section;

-- at least 50 seconds for the rotor of the second section.

During "run-down" observe the instruments and make sure that the decrease in engine rpm is smooth, without jumps, listen for unusual noises in the engine, and also check for flames and smoke coming from the nozzle.

17. After the engine has stopped switch off the pumps and close the fire valve. Place all switches in the off position.

18. After the engine has stopped close the cap on the air-intake duct and, after a 10 to 15 minute cooling down period, close the exit nozzle.

WARNING: 1. It is forbidden to stop the engine by closing the fire valve.

2. In an emergency situation involving shutting down the engine by closing the fire valve, the question of the further operation of the engine and the fuel assemblies (NR-30, TsR-1V and TsR-2V) must be decided by a representative of the manufacturing plant.

19. In an emergency the engine may be stopped by moving the engine control lever from any mode into the "Stop" position in the following cases:

-- a sharp drop in oil pressure at the engine intake;

-- the appearance of fuel or oil leaks;

-- a sharp increase in post-turbine gas temperature;

-- a sharp increase in the temperature of the oil at the engine intake when the engine is operating under steady conditions;

-- if the bypass valves do not open when there is a sharp gas drop below 70% (N_2 = 8,200 rpm);

-- the appearance of flame or heavy smoke from the nozzle exit;

-- the appearance of engine flutter or an increase in vibration rate to 90 mm/second;

-- the appearance of fire;

-- the appearance of unusual noises in the engine;

-- if the warning light indicating presence of metal chips in the oil goes on.

20. After an emergency shut-down of the engine for any reason listed above, further operation of the engine may be permitted by the manufacturer's representative after the cause of shut-down has been established.

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Peculiarities of Engine Operation in Low Temperatures

21. In order to prevent the formation of ice crystals in the fuel tanks, [antifreeze] fluid "I" in the amount of 0.1% of the total volume of fuel should be used.

22. Before starting the engines when the ambient air temperature is 0° C or below, check whether it is possible to turn the rotor of the first compressor section by hand. If this is not possible, warm the frozen area with hot air and check the rotation of the first and second compressor sections.

WARNING: It is forbidden to start the engine when ice or snow are present in the elements of the engine inlet duct. Ice should be removed with [air-]heating equipment. Ice should not be removed by scraping.

23. When the ambient air temperature is +5° or below with high humidity

(rain, drizzle, snow, etc.), the engines may be started and operated only after switching on the deicing systems for the engine air intake and the engine.

24. Before starting the engine, if the aircraft has been parked for more than two hours and the ambient air temperature is -30° C or below, it will be necessary to use the airport preheating equipment (the hot air temperature must be no more than 80° C) to heat the NR-30 regulator pump (in the vicinity of the automatic starter), the housing of the inlet guides of the first compressor section, the fuel-oil radiator and the oil tank for a period of at least 20 minutes until the oil temperature at the engine intake reaches +10° C.

Once the engine has been warmed up in this manner it should be motored before an attempt is made to start it.

25. After the engines have been shut down under conditions of negative ambient temperatures, the air intake and the exit nozzle should be closed with the caps to prevent the entry of snow into the engine.

Engine Shut-Down During Flight

In order to stop the engine it is necessary to:

1. Move the engine control lever to the idling position and operate the engine in this mode for at least one minute.

2. At the command of the pilot switch off the starter-generators of this engine.

3. Move the engine control lever to the "Stop" position.

After the engine has stopped:

-- close the cabin pressurization valve;

-- open the fuel cross-feed valve;

-- close the fire valve on the engine which has been shut down.

NOTE: During training flights the fire valve need not be closed after shutting down an engine.

4. In an emergency the engine may be stopped by rapidly moving the

2-21 4651 engine control lever from its original position to the "Stop" position in the following situations:

-- the appearance of strong vibrations (flutter) or an increase in vibration rate to (90 ?) mm/second;

-- a sharp increase in the post-turbine gas temperature;

-- a sharp drop in oil pressure at the engine intake;

-- fire in the engine;

-- a sharp increase in oil temperature at the engine intake under steady operating conditions.

Following an emergency shut-down of the engine it will be necessary to:

-- close the fire valve;

-- shut off the starter-generators;

-- close the cabin pressurization valve;

-- open the fuel cross-feed valve.

When the signal lamp marked "Metal Chips in Oil" goes on, observe the indicators denoting vibration rate, oil temperature and pressure, engine rpm, and post-turbine gas temperature to make sure that the engine is operating normally, and for the remainder of the flight pay particularly close attention to the engine operating parameters. Shut down the engine if there is a change in any of the above engine parameters.

Engine Start-Up During Flight

The engines may be started in flight if icing conditions are not present; the operation is carried out at the command of the pilot and at altitudes up to 7,000 meters.

An engine may be started in flight under the following conditions:

-- at altitudes up to 4,000 meters with an engine rotor autorotation speed of at least 10.5% (1,200 rpm);

-- at altitudes above 4,000 meters when the engine rotor autorotation speed is at least 13% (1,500 rpm).

Before an air start it will be necessary to:

-- place the aircraft in level flight;

-- make sure than the engine control lever is in the "Stop" position;

-- make sure that the fuel pumps are on;

-- make sure that the fire valve is open;

-- instruct the navigator to prepare for an air start.

After the navigator has reported that the engine is ready to start, the pilot gives the command "Starting Left (Right) Engine" and presses the air-start button for one to two seconds. At this time the signal lamp marked "APD Operating" should light.

Within 5 - 8 seconds after pressing the start button, having made sure that the green signal lamp which monitors APD operation is on, move the engine control lever to the idle stop, at which time the engine should automatically approach idling speed within a period of at least 120 seconds.

NOTE: When the engine control lever is against the idle stop, the idling speed will vary depending upon flight altitude. For every 1,000 meters of altitude, idling speed will be increased by approximately 1.5 to 3.5% (200 to 400 rpm).

Once the engine has started it should be warmed up in the idling mode for a period of at least one minute

2-22 WARNING: 1. If the engine speed has not increased within 45 seconds after the "Air Start" button was pressed, the engine control lever should be moved to the "Stop" position and the engine blown out at the autorotation speed for at least 30 seconds.

2. If two unsuccessful attempts to start the engine have been made, it is recommended that the engine autorotation speed be increased or the flight altitude be reduced before another attempt is made.

3. In the event of failure of the automatic starting system (the lamp marked "APD Operating" does not go on or goes out when the button is released), the engine should be started "manually." In this case the "Air Start" button should be depressed and held for 60 seconds (no more).

4. When an air start is made there may occur a sudden temporary rise in post-turbine gas temperature to 620° C; this temperature surge should not last for more than four seconds.

5. It is prohibited to start an engine in flight after it has been shut down by closing the fire valve.

Use of the Engine Control Levers

1. When starting an engine on the ground and in flight, the engine control levers are moved from the "Stop" position to the "Idle" position by pushing them forward to a vertical position and subsequently moving them against the idle stop.

2. Any movement of the engine control levers in flight from any position to the "Idle" position should be made smoothly, without interruption and excessive force.

3. In order to prevent accidental movement of the control levers when operating the engines on the ground or in flight, the levers should be braked by means of the hand brake [sic].

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2. THE FUEL SYSTEM

Brief Description

Fuel is carried in the aircraft in six integral wing tanks, which are formed by the inside of the center and outboard sections of the wing, which are hermetically sealed by appropriate means and equipped with the necessary fittings.

A schematic diagram of the fuel system is given in Figure 2.6.

Control of the aircraft's fuel system is automatic and is provided by an electronic adding fuel gage with signalling system SETS-470A.

The SETS-470A consists of three parts: an electrical capacitance fuel gage, an automatic fuel consumption device, and an automatic refueling device.

The electrical capacitance fuel gage is used to measure the amount of fuel contained in each tank as well as the total amount in the three tanks, separately for the left and right engines.

The automatic fuel consumption device regulates the consumption of fuel according to a prescribed program and signals the sequence of fuel consumption and the point at which 2,400 kg of fuel remain. Fuel consumption from tanks of the left and right groups is controlled independently. Consumption is regulated by transferring fuel from all three integral tanks into the fuel supply section of the second integral tank. The fuel is delivered from the fuel supply section of the second tank to each engine by means of two ETsN-45 pumps.

Fueling the Aircraft

1. The amount of fuel taken into the aircraft is dependent upon the flight program. The aircraft is refueled by means of the centralized fueling system or through the upper filler necks. [Footnote: The upper filler necks should be used for fueling purposes only under unusual circumstances or when the centralized fueling system has failed.]

2. Kerosene T-1 or TS-1 (GOST 10227-62) or TS-1G (MRTU12N 36-63), or D1655/63T type A1 (United States); DYeRD24494 (England) may be used as fuel for the engines.

NOTE: The U.S. and English fuels listed above may be used under conditions where the temperature of the fuel in the aircraft tanks will not drop below -45° C.

2. To prevent the formation of ice crystals in the fuel tanks at air temperatures of 0° C and below, fuel with an "I" fluid additive in the amount of 0.1% per total volume of fuel should be used.

3. Before refueling the aircraft make sure that:

-- there are fire extinguishing facilities in the vicinity of the aircraft;

-- the aircraft and tanker are grounded;

-- there is a release permitting fueling on the operational and

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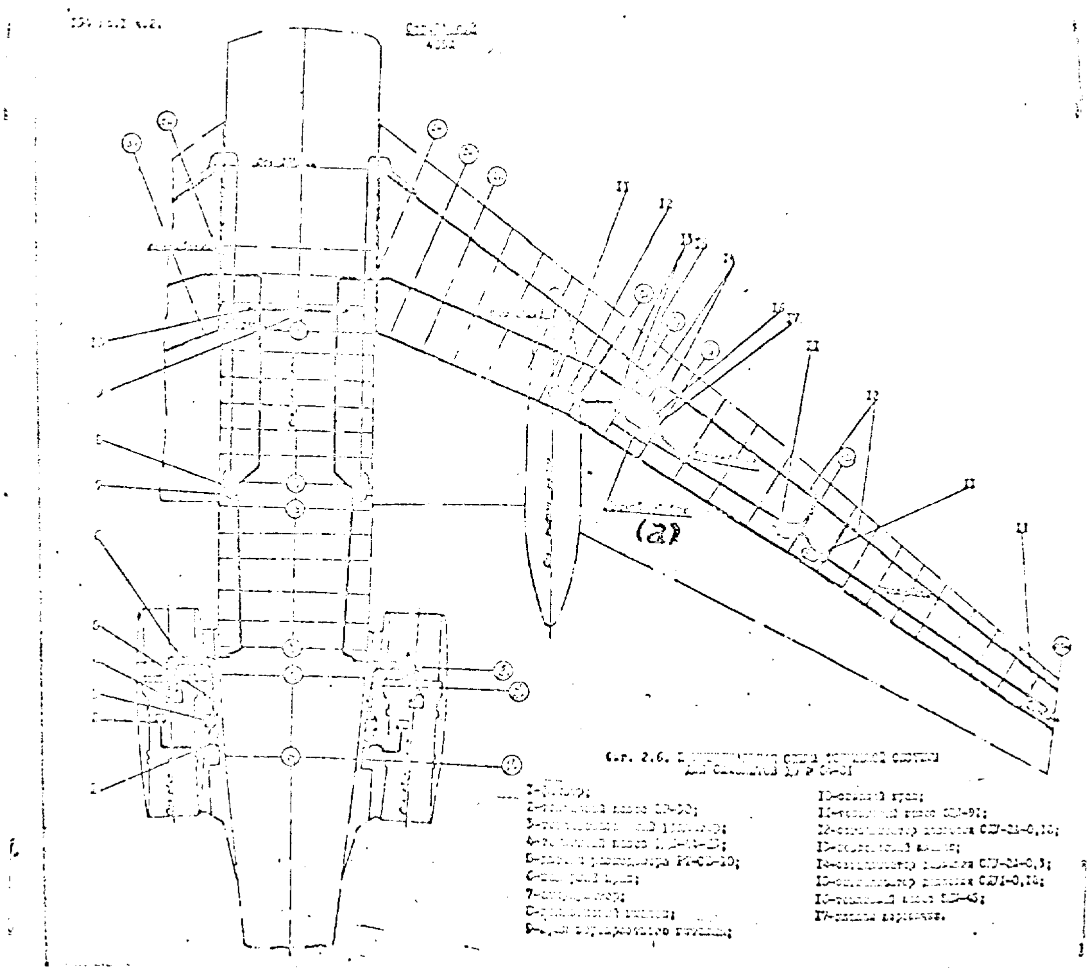

Figure 2.6. Schematic Diagram of Fuel System for Aircraft up to No. 04-01.

(1) Filter
(2) Fuel pump NR-30
(3) Fuel-oil radiator
(4) Fuel pump D??-44-P3
(5) Fuel flow transducer RT-SV-10
(6) Fire valve
(7) Storage battery
(8) (Socket-type ?) valve
(9) Cross-feed fuel cock
(10) Drainage cock
(11) Fuel pump Z??-91
(12) Pressure signalling device SLU-2A-0.18
(13) (Socket-type ?) valve
(14) Pressure signalling device SLU-2A-0.3
(15) " " SLU-0.18
(16) Fuel pump Z??-46
(17) Fuel transfer valve

(a) Fuel supply tank

technical data card for the fuel;

-- all residue has been drained from from the sumps of the refueling tanker. Draining of residue must be performed in the presence of a crew member (pilot or copilot) or a responsible member of the ground crew.

4. The procedure for fueling the aircraft using the centralized fueling system is as follows:

-- connect the airfield a-c and d-c power sources to the aircraft's electrical connection receptacles;

-- switch on the power to the aircraft's electrical network;

-- if no source of alternating current is available at the airfield,

2-25 465L connect the PO-500 converter;

-- connect the tanker hose to the filler neck;

-- place the fueling switch in the position corresponding to the required fueling variant ("P", "S" or "M");

-- place the fueling toggle switch in the "Fueling System On" position;

-- place the fuel gage switches in the "On" position;

-- place the main (common) fuel cock switch in the "On" position;

-- place the group fuel valve switches in the "On" position. The opening of the cock and valves is signalled by green indicator lamps;

-- give the command to turn on the tanker pump.

Simultaneously with the activation of the fueling switches a red lamp on the copilot's instrument panel should indicate "Fueling in Progress," and a green lamp should be illuminated on the fueling panel.

When the tanks have been filled the valves will close automatically and the green lamps corresponding to these valves will go out.

5. When the fueling operation is completed place all switches in the "Off" position and disconnect the tanker hose.

NOTE: 1. When the centralized fueling system is used, all integral tank groups may be filled simultaneously or each group may be filled individually in accordance with the graph shown in Figure 2.7.

2. In the event that one of the tank valves is not closed by the fixed level signal (the green lamp does not go out) or by the float mechanism (fuel continues to flow into the tank), and fuel intake is cut off by the triggering of the upper signalling mechanism which closes the main fuel cock (the green signal lamp for the main cock goes out), it will be necessary to check the fuel level in the tanks; if the fuel level is higher than the upper edge of the filler neck housing, a representative of the aircraft manufacturing plant should be called to determine the cause of failure of the valve and correct the malfunction and its consequences.

6. Once the fueling operation has been completed (in all cases), examine the fuel gages to determine that fueling was carried out correctly in accordance with Table No 1 and, on the basis of the fuel gage readings, set the pointers of the fuel flow meters to correspond to the amount of fuel which has been taken on.

7. The fueling process should be monitored by the readings of the counter on the tanker and the fuel gages.

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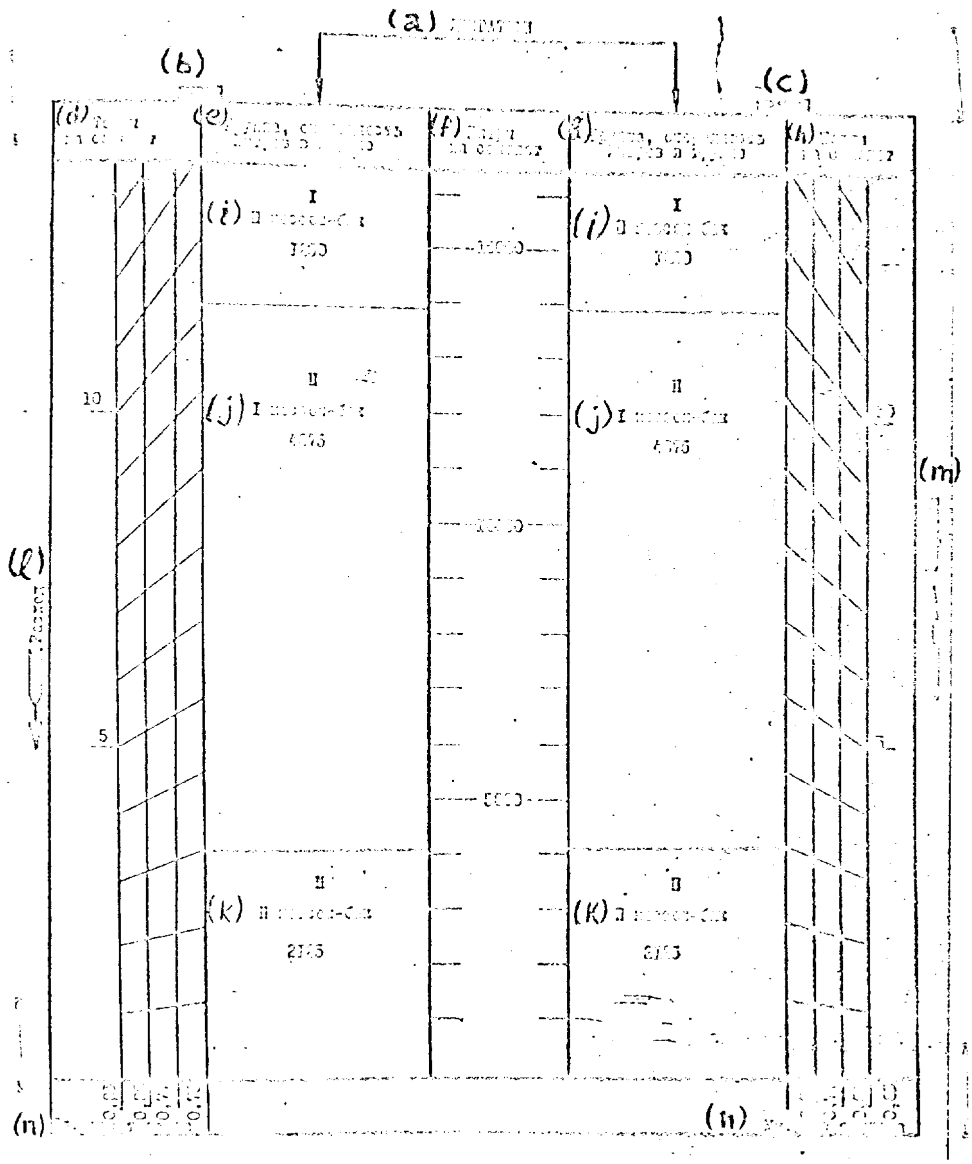

Figure 2.7. Graph of Sequence of Fuel Consumption and Fueling for Aircraft up to No. 04-01.

(a) Engines
(b) Left
(c) Right
(d) Tons in aircraft
(e) Group, sequence, liters in group
(f) Liters in aircraft
(g) Group, sequence, liters in group
(h) Tons in aircraft
(i) Third integral tank
(j) First integral tank
(k) Second integral tank
(l) Consumption
(m) Fueling
(n) Specific gravity of fuel

Centralized Fueling Variants. Table No 1

No.	Automatic Fueling Variants	Amount of Fuel, kg (γt = 0.80 g/cm^3)			
		1st Tank	2nd Tank	3rd Tank	Total
1.	Full fueling "P"	3,900	1,700	1,000	13,200
2.	Medium fueling "S"	3,300	1,700	-	10,000
3.	Low fueling "M"	1,900	1,700	-	7,200

NOTE: Wait 10-15 minutes after the fueling operation is completed, open the fuel tank drain cocks and drain off 0.5 liter of fuel from each tank. Make sure that water and other admixtures are not present in the fuel.

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In-Flight Operation of the Fuel System

1. For the purpose of maintaining the balance of the aircraft within given limits, when the automatic fuel consumption system is engaged fuel will be metered automatically according to the following program:

Sequence I -- total consumption of fuel from integral tank No 3

Sequence II -- total consumption of fuel from integral tank No 1

Sequence III -- total consumption of fuel from integral tank No 2

The sequence in which the fuel pumps are activated is designated by yellow signal lamps marked "Sequence of Fuel Consumption From Tanks." A signal lamp on the warning display panel will light when 2,400 kg of fuel remain for both engines.

2. In the event of failure of the automatic fuel consumption system, fuel transfer may be effected manually. The sequence of fuel consumption from the tanks is retained during manual control of fuel transfer.

To control fuel transfer manually:

-- place the switch marked "Fuel Transfer Automatic - Manual" in the "Manual" position;

-- determine the sequence of fuel pump activation by the lamps on the panel marked "Sequence of Fuel Consumption From Tanks;"

-- when the lamp labeled "Begin Transfer From Next Tank" goes on, place the appropriate switch labeled "Manual Engagement of Pumps" in the "On" position. Fuel consumption should be monitored by observing the fuel gage. The amount of fuel remaining in the 3rd consumption sequence (2nd fuel tank) must be within limits of 1,500 - 1,800 kg.

3. In the event of failure of the protective device (SDU 1-0.18) during manual or automatic control of fuel metering, the fuel pumps will switch off. To re-activate the fuel pumps the switch labeled "Forced Activation of Pumps" (beneath the protective red cover) should be placed in the "On" position and the fuel gages monitored to make sure that the amount of fuel remaining in the 3rd sequence is strictly within limits of 1,500 to 1,800 kg.

4. The operation of the fuel pumps should be observed by means of the signal lamps as follows:

-- the green lamp is on when the pumps are operating;

-- the lamp goes out when the pumps are not operating or there is no fuel remaining in the tanks.

5. Fuel reserve is monitored and measured on the basis of the readings of the fuel gages by successively switching between positions 1, 2 and 3 ("Group" and "Total") as well as by observing the fuel flow meter.

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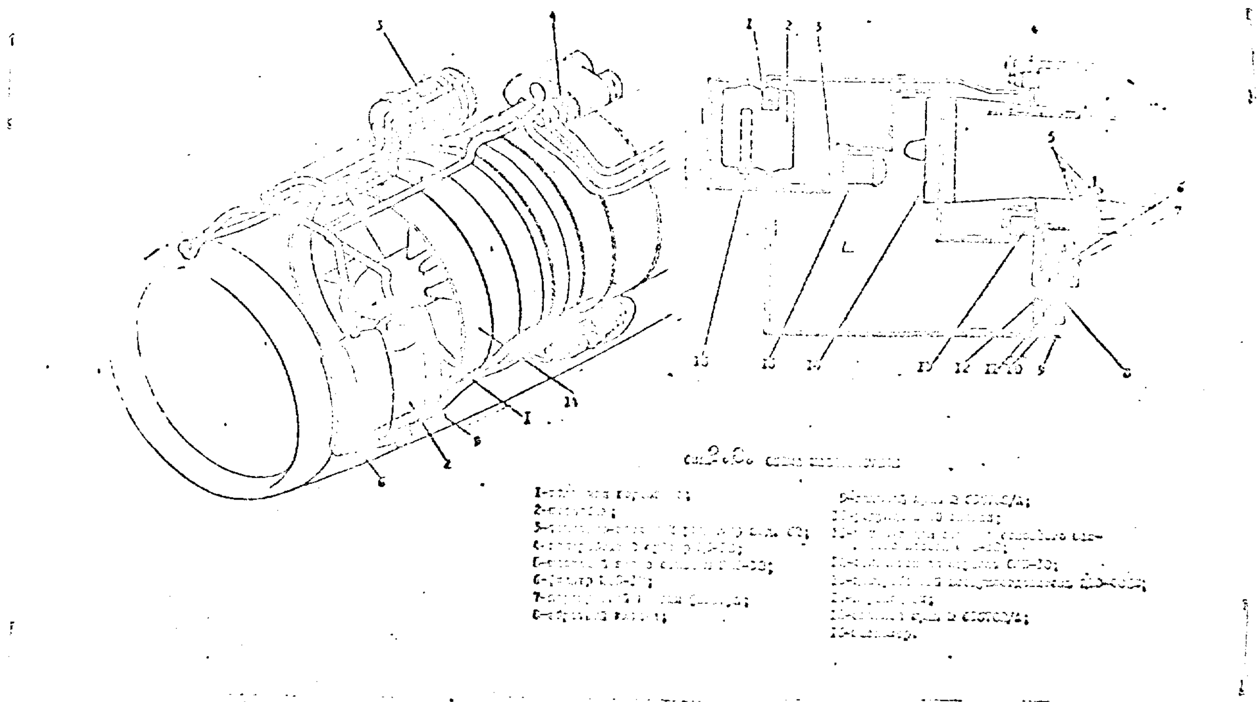

Figure 2.8. Diagram of Lubrication System.

(1) Filler neck
(2) Oil tank
(3) Fuel-oil radiator, part #62
(4) Centrifugal breather TsS-30
(5) Oil scavenging pump MNO-30
(6) Filter MFS-30
(7) Filter bypass valve
(8) Check valve
(9) Drainage cock No. 636700/A
(10) Reduction valve
(11) Pressure section of main oil pump OMN-30
(12) Scavenging section
(13) Centrifugal air cleaner TsVO-FS-30
(14) Adapters
(15) Drainage cock No. 636700/A
(16) Oil gage

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WARNING: After each fuel check, the fuel gage switch should be placed in the position corresponding to the second group of tanks.

3. THE ENGINE LUBRICATION SYSTEM

The engine lubrication system is an open-type system and includes the following components:

-- main oil pump OSN-30;

-- gauze strainer MFS-30;

-- oil scavenging pump MNO-30;

-- centrifugal-type air cleaner TsVO-FS-30;

-- centrifugal-type breather TsS-30;

-- cooling adapter (VNA ?).

2-29 A schematic diagram of the lubrication system is given in Figure 2.8.

The oil used in the D-30 engines may be types MK-8 (GOST 6457-53) and MK-8P MRTU-12N No 12-62, or MI-0-6081 B grade 1010 (U.S.), or D. Eng. RD 2490 (England).

The steps outlined in paragraph 3 of the section "Fueling the Aircraft" should be carried out before the lubrication system is serviced.

The oil tank should contain at least 20 liters of oil. Oil may be added until it reaches the level of the filler neck in the oil tank.

Oil temperature and pressure are monitored by means of three-needle indicators EMI-3RTI (separate indicators for the left and right engines) which are located on the center instrument panel; lighting of the signal lamp labeled "Chips in Oil" indicates the presence of metal chips in the FS-30P chip-detecting filter.

The EMI-3RTI instruments are activated by the automatic circuit breake

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4. THE FIRE PROTECTION SYSTEMS

The aircraft is equipped with two independent fire protection systems: one in the engine nacelles and the other in the engines.

1. The fire protection system in the engine nacelles consists of six OS-8M fire extinguishers, charged with a fire-extinguishing Freon compound $114B_2$, which are triggered in three sequences of two extinguishers per sequence.

The extinguishers in the first sequence are activated automatically by the SSP-2A signal system, while those in the second and third sequence are activated manually by pressing buttons on the pilot's overhead electrical panel.

2. The fire protection system within the engines consists of two OS-2IL fire extinguishers, charged with a fire-extinguishing Freon compound $114B_2$, which are triggered in two sequences of one extinguisher each. The extinguishers in the first sequence are activated by pressing the appropriate button labeled "Fire Protection System On" when a fire is detected visually. The second sequence of fire extinguishers is activated in both engines by pressing the appropriate button after the extinguishers of the first sequence have been exhausted.

WARNING: The system for signalling a fire within the engines is not activated in the aircraft.

3. Fires originating in the passenger compartments and crew cabins may be extinguished by means of two portable OU fire extinguishers mounted in the passageway and on the rear bulkhead of the passenger compartment.

4. To prevent fire from breaking out in the engine nacelles as a

result of possible damage when an emergency landing is made with the landing gear retracted or in the event of collapse of the nose or main landing gear, provision is made for emergency activation of all six fire extinguishers by an impact-actuated mechanism; this mechanism also disconnects all starter-generators.

The impact-actuated mechanisms are mounted on the forward struts (drag braces ?) of the main landing gear assembly in the forward part of the fuselage and in the wing cantilevers. The mechanisms are actuated when they strike the ground.

The crew's actions in the event of a fire are outlined in section 4 of the second chapter, "EMERGENCY FLIGHT CONDITIONS."

Checking the Fire Protection System

The pre-flight check of the system involves the following:

-- switch off the automatic circuit breakers which control the fire-extinguishing bottles;

-- switch on the automatic circuit breakers of the fire protection system;

-- switch on the main fire protection system switch;

-- check the operation of the fire-signalling button-lights by pressing each one in turn and making sure that they light. This indicates the opening of the electromagnetic (solenoid) valves and closing of the generator blow-off flap valves;

-- turn off and then turn on the main switch; the button-lights should go out;

-- switch on the automatic circuit breakers which control the fire-extinguishing bottles and make sure that the white lamps are on.

5. ELECTRICAL EQUIPMENT OPERATION ON THE GROUND & IN THE AIR

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Aircraft Ground-Source Power Supply

The navigator controls the electrical power network of the plane with controls mounted on the electrical power control panel.

As a rule when the engines are not operating, the plane obtains its source of electrical power from the airport's electrical power source of 28.5 volts direct current and 115-volt 400-cycle alternating current.

To connect the airport supply source to the plane, electrical plug receptacles ShRAP-500 No. 1 and No. 2 (direct current) and ShRA-200 (alternating current) are mounted between frames 48 and 49 to the left of the fuselage axis.

The connection of the airport's 28.5-volt direct current supply to the plane's on-board system is made in the following order (through ShRAP-500 No. 1):

-- make sure that all on-board circuits that consume electrical power are turned off;

-- the airport's supply switch is turned off;

-- the voltmeter switch is in the "RAP No. 1" position;

-- attach the airport supply cable receptacle to the aircraft plug and suspend the cable by hooking it to the safety cable;

-- turn on batteries;

-- if the airport's supply voltage registers in the 27 — 28.5-volt range on the voltmeter, turn the airport supply switch to "on" and switch the voltmeter to the "circuit" position. Set the battery bus switch to the "circuit" position.

The current consumed from the airport supply is monitored by the on-board battery ammeter and automatic start relay. The batteries in this case need not be switched off, since the plane is provided an automatic disconnect of the on-board circuit and airport power source at all times.

Connecting the 115-volt 400-Hz alternating current airport supply to the on-board electrical system is done in the following sequence:

-- set the airport supply switch to off;

-- using an alternating current voltmeter, check for voltage on the main and auxiliary bus bars of the circuit. If there is voltage on the main bus, check the PO-4500 converter switch setting and set it to neutral.
2-32 465I If there is voltage on the auxiliary bus (spare converter operates the copilot's or navigator's window defroster), the converter is automatically disconnected when the airport supply is connected;

-- attach the airport supply cable receptacle to the airplane plug.

Checking the operation of the plane's alternating current electrical system under full load when the on-board system is using the 115-volt 400-Hz airport source is not difficult, since the main and auxiliary bus bars are supplied energy at the same time. It is not necessary to turn on the spare converter in order to check the copilot's or navigator's window defroster.

When using the airport supply for the plane's on-board circuit, the direct and alternating current bus voltages must be periodically monitored.

If there is no 115-volt 400-Hz alternating-current airport supply, the on-board PO-4500 converter may be used to supply the alternating-current power on the plane.

If the PO-4500 converter fails, the main bus bar is automatically switched with the aid of the KPR-1 box to the auxiliary converter; the auxiliary bus bar is disconnected. The white lamp labeled "Spare PO-4500 Operating" lights up on the navigator's panel when the spare PO-4500 is operated.

In addition, it is possible to connect the spare PO-4500 converter to the main bus bar by hand.

NOTE: If the excessive revolutions of the centrifugal switch cut off the PO-4500 converter, it can be restarted by switching the converter switch off and on.

PT-1000TsS on-board converters are used to supply three-phase 36-volt 400-Hz alternating current, one of which is operational and the other is a spare. The alternating three-phase current circuit is automatically switched to the spare PT-1000TsS converter supply during a main-converter malfunction. It is possible to switch on the spare PT-1000TsS converter by hand. When the spare PT-1000TsS is operating, the red lamp labeled "Spare PT-1000TsS Operating" lights up on the navigator's panel.

Voltage Regulation and Adjustment of the STG-12TMO-1000 Starter-Generator for Parallel Operation

When operating the STG-12TMO-1000 starter-generators be sure that their voltages stay in the range of approximately 28.5 volts, the load current at each starter-generator does not exceed 120 amperes on the ground and 400 amperes in the air, and that the difference of the loads is no more than 40 amperes during maximum circuit load.

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The VS-25B rheostats mounted on the navigator's electrical control panel, regulate the voltage and permit voltage changes within a range of -1.5 to +3 volts.

Voltage regulation is carried out whenever the starter-generator or the P series RN-180 voltage regulator is replaced and also whenever the voltage rises above 28.5 volts or drops below 27 volts.

When regulating the voltage, switch the starter-generator off, and set the voltmeter switch to the starter-generator being adjusted.

Increase (clockwise) or decrease (counterclockwise) the starter-generator voltage to 28.5 volts by turning the VS-25B rheostat knob during rated (92 to 93 per cent) engine revolutions. Next, decrease the engine rpm to minimum (53 to 54 per cent) and check the starter-generator voltage, which must not decrease more than 1 to 1.5 volts.

When necessary, regulate the voltage of the remaining starter-generators in the same way by switching all four starter-generators to parallel operation, check the voltage with the voltmeter, and set to the electrical circuit mark for 28.5 volts. Check the uniformity of load distribution between generators within 20 - 30 minutes of flight and make any necessary readjustments.

The parallel operation of the starter-generators is adjusted whenever the load of one rises above 400 amperes and when their load current differs significantly from each other (more than 40 amperes).

When the load of one of the starter-generators is higher than 400 amperes, lower the voltage by turning the VS-25B rheostat knob in a counterclockwise direction and adjust its load to the level of the others. If the use of rheostat VS-25B does not drop the load of the overloaded starter-generator, switch it off and do not use it until repaired.

When aligning the parallel operation of the starter-generators increase the on-board circuit load to maximum by switching on both PO-4500 converters, electrical instruments, etc. Obtain a uniform starter-generator load by alternately rotating the VS-25B rheostat knobs in different directions (each no more than one division, which is fixed by a spring-loaded detent):

-- turn rheostat for overloaded starter-generators in a counter-clockwise direction;

-- turn rheostat for underloaded starter-generators in a clockwise direction while continuously monitoring the on-board circuit voltage, which must not deviate outside the 27-to-28.5-volt range.

2-34 / 465L After equalizing the starter-generator loads, switch off all the auxiliary power circuits.

During a malfunction of all the starter-generators or if both engines stop in flight, the emergency direct-current network is disconnected from the main supply and obtains its supply from the on-board batteries; the emergency alternating current circuit is switched to the PO-500 converter.

When necessary the main network is connected to the batteries by depressing and releasing the button labeled "Connecting the batteries to the network after engines stop".

Automatic Overvoltage Protection of the On-Board Electrical Circuitry

Keep in mind that an overload of one of the starter-generators above 400 amperes may be a result of a sharp voltage increase due to a malfunction of the excitation circuit or voltage regulator.

A continuous on-board circuit overload can cause failure of electron tubes, electrical aircraft instruments, converters, and other electrical components.

To protect the on-board electrical network from overload a AZP-8M IU-series device is installed in the plane. This device trips automatically and disconnects the defective starter-generator within 1.5 seconds after a voltage higher than 34 volts appears at its terminals.

After correcting the cause of the overload the starter-generator is switched in by depressing the button on the lid of the overload device. All the AZP-8M IU series devices are installed on shelves in the rear baggage compartment along with the RN-180 series-P voltage regulators.

Automatic Protection of Electrical Equipment Circuitry

Along with the usual safety fuses of the SP type, lag and high-melting fuses of the IP and TP type, the electrical equipment circuitry is protected by automatic circuit breakers of the AZS type for currents from 2 to 40 amperes.

The majority of the AZS are mounted on the left and right AZS panels, pilot's AZS panel, and the stewardess's panel. These automatic devices are always turned on. Switch off only those individual AZS devices located on the navigator's and steward's electrical control boards which are used simultaneously as automatic devices and as unit and instrument control whenever the operational need is no longer necessary. Among the automatic devices are the electrical kitchen instruments, the lighting, and the navigational system.

During a failure in one or another cable line, a current flowing in the equipment circuitry exceeds the rated current of the AZS device causing it to switch off automatically, thus disconnecting the defective circuit.

2-35 Keep in mind that within 2-3 minutes after the automatic AZS trips it may be switched back on. If after the circuit breaker is switched on it again trips to disconnect the circuit, it should be left switched off since frustrating the circuit breaker function may cause fire in the wiring or damage equipment (electric motors, electric mechanisms, relays, instruments, etc.)

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6. THE HYDRAULIC SYSTEMS

Brief Description

The plane is equipped with three independent hydraulic systems:

-- primary hydraulic system;

-- auxiliary hydraulic system;

-- brake hydraulic system.

1. The primary hydraulic system is designed to actuate the following:

-- the retraction and extension of the landing gear and the opening and closing of the flaps;

-- steering of the forward landing-gear wheels;

-- the spoilers;

-- the windshield wipers;

-- the hydraulic rudder boosters GU-108D.

Monitoring the operation of the primary hydraulic system is accomplished by a pressure guage and a SIM-61 signal lamp installed on the pilot's central instrument panel. The SIM-61 lamp will light up with a pressure drop in the primary hydraulic system below 190 kg/cm^2.

2. The auxiliary hydraulic system is intended to operate the hydraulic rudder booster in the event the primary hydraulic system fails.

The auxiliary hydraulic system is controlled by means of the 2PPNG-15K switch mounted on the pilot's upper electrical power panel. The system enters into operation automatically when the pressure in the primary hydraulic system drops below 100 kg/cm^2. The hydraulic system may be made to operate by setting the 2PPNG-15K switch to the override position.

3. The brake hydraulic system is intended for normal emergency wheel braking and emergency landing gear extension.

The pressure in the hydraulic system is automatically maintained in the 170-210 kg/cm^2 range.

Monitoring the operation of the hydraulic system is done through a red signal lamp installed on the pilot's central instrument panel. The lamp lights up when the pressure in the system drops below 140 kg/cm^2.

Emergency wheel braking is employed only when the operation of the main wheel braking system fails.

Simultaneous use of the primary and emergency braking systems is prohibited.

The emergency extension of the landing gear by the brake hydraulic system is done as indicated in "Special Situations" section 6.

Landing-Gear Retraction by Primary Hydraulic System

-37
4657 In-flight landing-gear retraction by the primary hydraulic system is done in the following way:

-- place the handle of switch PPNG-15K on the upper electrical control panel in the "retraction" position. At the start of the retraction cycle, the green landing-gear signal illuminates; at the end of the operation, after the landing gear is locked in the retracted position, the red lamps light up;

-- hold the system under 200-210 kg/cm^2 pressure for 5 seconds after the last red lamp lights up and then throw the PPNG-15K switch handle to the intermediate (neutral) position.

Landing-Gear Extension by Primary Hydraulic System

The extension of the landing gear in flight by the primary hydraulic system is done in the following way:

-- throw the handle of the PPNG-15K switch to the "extension" position;

-- after the extension position signal lamps light up and the system pressure builds up to 210^{+10}_{-7} (within 20-30 seconds), set the landing-gear switch to "neutral" position.

NOTE: Extension of the front strut may be checked through a viewing window by the position of the flag on the drag-link mechanism. During extension, the white surface of the flag will be presented toward the window.

Steering the Forward Landing-Gear Wheels

Control of the forward wheel steering is done directly by the plane's foot control pedals and occurs together with the rudder deflection.

The control system has four steps of deflection:

-- deflection corresponding to taxiing with ±35° of flap;

-- deflection corresponding to the take-off and landing run of the aircraft with full rudder deflection ±5° from the neutral position;

-- deflection corresponding to special taxiing with ±35° of flap;

-- deflection corresponding to free front-strut orientation. This position is established automatically after take off and after the VG-15K
2-38 front-wheel steering control is switched off. Prior to take off the system is switched automatically to take-off operation while the flaps are extended for take off. After the front strut leaves the ground it independently is set to an average neutral position and remains there throughout the flight.

In the event the hydraulic-system pressure falls, the control system automatically switches to a self-aligning operation. When necessary the front landing-gear wheel-control system may be changed to self-adjusting operation by switching off the VG-15K switch.

During landing, the system is automatically switched on for a landing operation. To switch to the taxi operation, the aircraft captain must depress and release switch VBG-15K. During an emergency switch-over to taxi operation, the VBG-15K switch must be depressed and held until the taxiing is completed.

7. THE AIRCRAFT BRAKING SYSTEMS

Automatic Brake Control

An automatic [anti-skid] wheel braking system is employed in the aircraft to provide the best wheel adherence to the runway surface, thereby decreasing the length of the landing run. At the same time the system protects the tires from the destructive "Hughes" effect.

The automatic braking system is switched on by the VG-15K switch located on the pilot's upper electrical panel and functions only when the brake pedals are depressed and the brake lines have hydraulic fluid pressure.

The operation of the automatic braking system is monitored by the SIM-61 yellow lamps on the pilot's upper instrument panel. Flickering of the lights during landing indicates normal automatic system operation.

Spoiler System Control

The spoiler control system is served only by the primary hydraulic system. The spoiler activator switch is located on the left panel, and the trip switch is on the right horn of the pilot's control yoke.

Monitoring the unretracted position of the spoilers is done with the two signal lamps located on the pilots' central instrument panel (the lamps are lit when the spoilers are unretracted).

2-39 The spoilers are extended by depressing the button on the trip switch at the moment the plane's main landing-gear wheels touch the runway.

Wingflap Control

Extension and retraction of the wingflaps is done with the aid of an electrical mechanism.

The electrical mechanism is switched on by throwing the switch installed on the pilot and copilot's panels to "extend" or "retract" position.

Extension and retraction of the wingflaps is monitored by the UPZ-47 indicator located on the pilots' central instrument panel.

An audible signal warns against the aircraft taking off with the wingflaps retracted or not extended to takeoff angle.

Landing Flap Control

The landing bellyflap is extended and retracted by means of an MPZ-18 electrical mechanism, which in turn is actuated by means of the copilot's and pilot's ZPPNG-15 switches.

The landing flap position is monitored by means of the UZP-47 installed on the pilots' central instrument panel.

Landing Parabrake [Drogue Chute] Control

The landing parabrake is designed to reduce the length of the landing rollout. It is deployed by depressing one of the "Parabrake Deploy" pushbuttons located on the right and left sides of the flight deck; the parabrake is detached by depressing one of the "Drop Parabrake" pushbuttons located on the pilots' instrument panel.

Parabrake deployment is monitored by means of a green lamp which illuminates when the parabrake is in deployed position.

8. THE COMPRESSED-AIR SYSTEM

The aircraft compressed-air system is intended for use in closing the starter-generator ventilation baffles so as to extinguish a fire in the engine pod(s), and for opening the drogue-chute bay door and parpbrake release.

The system supply source is a 3-liter tank of air compressed at 150 kg/cm^2 pressure. The system is charged

2-40 465L with compressed air while on the ground.

The process of charging with the compressed air is monitored by means of an MV-250M manometer. Depressing one of the "Parabrake Deploy" buttons located on the right and left sides of the flight deck causes the drogue chute bay door to open and the parachute to deploy.

The parabrake detatch lock is released by means of one of the buttons marked "Drop Parabrake", which are located on the left and right instrument panels.

The starter-generator ventilation baffle is closed automatically when extinguishing a fire in an engine pod.

9. DEICERS AND ELECTRICAL HEATING DEVICES

Brief Information

This aircraft is equipped with the following devices for combatting icing-up of the aircraft and fogging-up of the crew-compartment windows:

-- a radioactive signal indicating the presence of ice on the aircraft;

-- hot-air wing and tailfin leading-edge deicers;

-- hot-air engine air-duct intake deicers;

-- hot-air deicers and warning signal for icing-up of engine guide vanes and bullet fairings.

-- electrothermic deicers for the stabilizer;

-- electrothermic defrosters for crew-cabin windows;

-- electrothermic deicers for the pitot heads, which supply total and static pressure to the membrane-aneroid instruments.

Wing, Tailfin, and Engine-Intake Deicers

The wing and tailfin leading edges are heated by warm air bled off from the fifth stage of the compressor second section; the engine intakes are heated by bleed-air from the fifth and tenth stages of the compressor second section.

A red-filtered lamp on the copilot instrument panel signals the presence of ice. The lamp lights up when the RMO-2M ice alarm trips.

The wing, tailfin, and air-duct intake deicers are switched on by means of the 2PPG-15K switches installed on the copilot's instrument panel.

Actuation of the wing, tailfin, and engine-intake leading-edge deicers is monitored by means of white signal
2-41 lamps illuminating on the signal board in the passageway
4651 between the passenger cabin and the rear baggage compartment.

The temperature of the air feeding into the wing deicer is monitored by means of the TTsT-1 thermometer.

Engine [interior] Deicers

1. The engine deicer is intended to warm the guide vanes of the first compressor section and the bullet-fairing with warm air which is bled from the fifth and tenth stages of the second compressor section.

Switching the air bleed-off from the tenth to the fifth stage is done automatically.

2. On and off switching the air supply to the guide vanes is done by the cover valve of the MP-51 electrical mechanism.

3. The heat may be turned on manually or automatically. Manual switching is done with a switch on the copilot's instrument panel.

4. A white light on the copilot's instrument panel indicates icing on the guide vanes and engine bullet-fairing.

Aircraft Deicer System Check

1. To check the operation of the wing and tailfin deicer while the engines are running, set the "wing and tailfin" deicer switch to the "on" position (2-3 times) and check the maintenance report to see that a stream of warm air is flowing from the louvers of the wing fairings. To avoid overheating the wing and tailfin leading edges, the deicer should not be switched on for more than 1.5 minutes while on the ground. Deicer operation is monitored by reading the TFsT-1 and illumination of the valve-open-position lamps on the monitor panel. After checking, throw the control switch to the "off" position until the flap is closed.

NOTE: The tailfin deicer is not checked individually since the deicer shut-off flap-valve is common to the wing and tailfin deicer.

2. Conduct a check of the pitot-head deicers by turning on their switches and depressing the monitoring buttons. If they are malfunctioning, the deicer signal lamps located above the push-button will light up.

2-42 Stabilizer Deicer

1. The stabilizer leading edge is equipped with electrical deicing units having dual action, i.e., consisting of leading-edge surface units which are continuously connected to a "knife" element electrical circuit and units which are alternately connected to the electrical circuit.

2. The stabilizer deicer is switched on by the PPG-15K switch on the copilot's instrument panel. It should be remembered that the service-instrument supply bus is disconnected when the stabilizer deicer is switched on.

3. Deicer operation is monitored by means of a SLM-61 white light installed on the copilot's instrument panel.

The working condition of the stabilizer deicer is checked on the ground with a special tester NTPP-1.

4. In-flight operation of the deicer is monitored by the blinking of the lamp located on the copilot's instrument panel. If the deicer fails (the lamp does not blink), avoid flying in icy conditions.

Pitot-Head (PPD) Deicers

The pitot-head deicers are equipped with electrical heaters to prevent icing up.

The heaters are switched on by the two VG-15K switches located on the pilots' upper electrical panel.

The pitot-head deicer is turned on by an actuator mechanism prior to take-off, and is switched off after landing.

Crew-Cabin Windshield Defrosters

The pilots' and navigator's cabin windshields are equipped with electrical defroster units to eliminate icing and condensation.

An ASS-3M automatic window defroster is installed for maintaining a given defroster temperature and to protect against overheating.

The defroster of each windshield is turned on by its own switch. The window defroster switches of the pilots' cabin are installed on the pilots' upper electrical panel; the navigator's cabin defroster switch is mounted on the navigator's switch panel.

The electrical window defroster must be switched on before entering into a potentially icy zone.

It is recommended to have the electrical window defrosters switched on during the entire flight when flying through mixed weather. If the window outer glasswork is cracked in flight or during parking, it is permissible to fly with such a window to the home base or destination, with the window defroster switched off.

Using the Windshield Wipers

1. Treat the side windows of the flight deck with TG-10 waterproofing fluid prior to take off.

2. The pilots must turn on the windshield wipers during take off and landing in rainy or snowy conditions. Depending upon the intensity of the rain or snowfall, maintain the sweep rate of the windshield wipers within the range of 100 to 200 a minute.

3. To switch on the windshield wipers in flight or during landing, uncover the batching valves GA-230 located in recesses on the crew cabin walls.

4. It is permissible to turn on the windshield wipers when flying below speeds of 450 km/hour.

Checking Windshield Wiper Operation

Operation of the GA-230 windshield wiper is checked at a hydraulic-system pressure of 210 kg/cm^2 by means of the ground hydraulic-testing unit. Before checking the cabin windows, wash the wipers to remove the dust.

There should be no more than 8 sweeps of the wipers when operating the windshield wipers on a dry window. For longer operation, wet the windshield surface with water in above-freezing temperatures and with alcohol in below-freezing temperatures.

The force of the wiper-blade pressure must be 6.5 ±0.2kg.

10. OPERATION OF THE AIRCRAFT

Stabilizer Operation

An adjustable stabilizer is installed on the aircraft to extend the range of operational trimming. The adjustment of the stabilizer is made by means of the MUS-7A electrical mechanism.

The MKV-38 terminal-switch mechanism limits the deflection range of the stabilizer from 0° to -2.5°.

Stabilizer control is accomplished by either pilot, using the 2PNG-15 switches mounted on the pilot's trimmer panel and the copilot's electrical control panel.

2-44 Stabilizer deflection is monitored by the UPS-1 indicator mounted on the central instrument panel.

Aileron Operation

The ailerons are operated by means of the control wheels mounted on the steering columns. Aileron control may be performed by both pilots simultaneously or individually.

The manual aileron control is not connected with the aircraft's hydraulic system. The roll gradient at the control yoke is due to the aerodynamic aileron hinge moment.

A special spring loader is installed in the aileron control system so that normal aileron feedback force is exerted on the control yoke. The spring loader is connected to the aileron control system continuously.

Aileron Trimtab Control

The electrical aileron trimtab mechanism is controlled by two 2PNG-15 pressure switches mounted on the pilot's and copilot's trimtab panels.

The SIM-61 white lamps mounted on the pilot's trimtab panels indicate the neutral aileron trimtab position.

Rudder Operation

1. The rudder (R.N.) is controlled by means of the pedals mounted on the pilots' pedestal, by either the pilot or copilot.

2. In the rudder control system is installed a GU-108D non-reversible single-chambered hydraulic booster which is fed from the primary hydraulic system or, in the event of system failure, from the NG45 emergency hydraulic system. The hydraulic booster supply is automatically switched to the emergency system when the pressure in the main system falls. Normal rudder control is done with the aid of the hydraulic booster.

The possibility of switching over to unassisted pedal control is provided in the event the hydraulic booster or hydraulic system malfunctions.

Transferring to pedal control is done automatically when the pressure in both hydraulic systems falls or when the GU-108D is switched off.

3. During booster-assisted operation of the rudder controls, an artificial load is placed on the pedals by means of a spring-loaded take off-and-landing counterforce.

4. A take off-and-landing counterforce trimming mechanism has been installed (on the aircraft) to reduce (where necessary) the pedal forces exerted by the spring counterforces.

2-45 465L 5. To limit rudder deflection at high speeds, a flight-mode counterforce loader installed in the control system is switched on automatically when the flaps are retracted.

A signal lamp lights up when the rudder is deflected more than ±5° in flight (when the counterforce is switched on); the signal lamp is located on the instrument panel of the pilot.

Rudder Trimtab and Trim-Mechanism Operation

The electrical rudder and the trim mechanisms are actuated by means of the two 2PKG-15 pressure switches mounted on the pilot and copilot trimmer panels.

The electrical trimtab -deflection mechanism and the electrical mechanism for trimming the spring-loaded rudder counterforce operate separately, but are activated by the same switches. With the hydraulic booster switched on, the trimming mechanism is connected to the control switch, but when the hydraulic booster is switched off, the electrical trimming mechanism is switched in.

The neutral position of the rudder trimtab and the spring-loaded counterforce are monitored by means of illuminating white lights on the pilots' trimmer panels. The lights are mounted in pairs on each panel above the switches.

Engagement of Rudder Hydraulic Booster and Emergency Crossfeed Control Valve

The (GU-106D) rudder hydraulic booster is supplied from the primary and auxiliary hydraulic system. The engagement of the hydraulic rudder booster is done with the BPG-15K switch mounted on the pilots' upper electrical control panel.

In the event of strong rudder forces or spontaneous pedal oscillation, the hydraulic rudder booster and the emergency crossfeed control valve must be switched off immediately and then revert to pedal control.

Elevator Control

Control of the elevators is manual and is not connected with the aircraft hydraulic system. The forces on the control columns are created by the aerodynamic hinge moment arising at the elevators.

2-46
465L Elevator control is accomplished by the two control columns simultaneously or individually by both pilots. The kinematic coupling between the control columns is effected structurally by means of rigid control rods and rockers.

The elevators are provided with trimtabs, for balancing the plane, which are controlled by two systems: a duplicate mechanical cable, system which is engaged by rotating the control wheels mounted on the pilots' panels, and the primary electrical system which is engaged by the UT-15 electrical mechanism. The electrical mechanism is controlled by switches mounted on the spokes of the aileron control yokes, and by the AT-2 automatic trimmer whenever the autopilot is switched on.

Elevator Trimtab Control

The elevator trimtabs have electrical and back-up mechanical controls.

The electrical mechanism is controlled by the FHG-15K pressure switches mounted on the pilots' control-yoke spokes. When the trimmers are controlled electrically they are deflected up and down ±4°30'.

To increase the deflection angle of the elevator trimtabs to a complete 8°30', the mechanical trimmer control must be used.

An emergency-deflection electrical trimtab control is engaged by the BG-15 switch on the pilots' upper electrical panel.

The positions of the trimmers are monitored by the A812V terminal switches assembled on the distributor cable drum.

The DR-134M Yaw Damper

The DR-134M yaw damper is intended to improve the lateral stability and control characteristics of the aircraft in all flight modes when the autopilot is switched off.

The yaw damper is made up of two self-contained channels whose actuating mechanisms (RAU-108 steering control apparatuses) are series installed in the rudder control system.

Both channels of the damper are switched on before take-off and switched off after landing.

The roll damper (signal ω_x) is interlinked with the flaps and used only on take-off and on landing. On the left instrument panel is a warning signal panel which indicates signal ω_x left on, and with a superscript for limiting the use of the damper below speeds of 400 km/hour. The course damper (signal ω_y) is used for all flight modes.

The DR-134M damper operation is monitored by the illuminating of green lights and by the meter needles visible on the PMK-134B channels 1 and 2.

An automatic damper disconnect is activated when the autopilot is switched on, when the hydraulic system pressure falls, and when the hydraulic rudder booster GU-108D is switched off.

Aircraft Operation Check with [External] Power Source Engaged

1. Before checking the control system of the aircraft, check to see that:

-- the hydraulic rudder booster switch lever is in the "off" position;

-- the AP-6EM-3P autopilot is switched off;

-- the rudder hydraulic-booster emergency-crossfeed valve switch is in the "off" position.

2. Check the working condition and the deflection smoothness of the aircraft control elements (ailerons, elevators, rudder, and trimtabs.)

NOTE: When checking the working order of the flaps, ailerons, and their trimtabs, place one of the crew members on the ground to report to the ship captain the position of the control unit being checked. The trimtab deflection is checked from both pilots' seats.

After checking the control units, place the ailerons, rudders, elevators, and their trimtabs in the neutral position.

WARNING: When using the electrical mechanism to check the deflection of the trimtabs on the ailerons, rudder, and elevators, do not depress the pressure switches mounted on the pilots' panels at at the same time.

3. Check the working order and smoothness of the stabilizer deflection.

When the stabilizer control switch is depressed away from you, it must deflect to an angle position of 0° according to the stabilizer position indicator. When the switch is depressed toward you the leading edge of the stabilizer must be down -2.5° according to the stabilizer position indicator.

Aircraft Operation Check with Engines Operating

1. Check to see that the aircraft controls are released.

2. Switch on the GU-108D hydraulic rudder booster.

3. Ascertain that the rudder control system switches on automatically when the GU-108D hydraulic booster is engaged, and that the rudder-trimtab neutral-position indicator lamp is out and the neutral position lamp of the electromechanical take-off--landing counterforce trimmer is on. The pilots' pedals must be in the neutral position.

Check that the build up of pedal forces is proportional to the rudder deflection-angle increase when the pedals are displaced and that the deflection of the rudder is smooth.

4. Check the operation of the electrical trim mechanism. Check that when the control switch of the electrical trim mechanism is depressed to the left, the left pedal moves forward and the rudder is deflected to the left. When the switch is depressed to the right, the right pedal must move forward and the rudder must be deflected to the right. After checking, set the electrical trim mechanism to the neutral position so that the signal lamp lights up.

5. Check the operation of the flight-mode rudder counterforce.
-- set the flight-mode counterforce switch to the "on" position which

causes the "flight mode counterforce" signal lamp to light up;

-- check the forced disengagement of the flight-mode counterforce by setting the switch to the "forced-disengage" position. The flight-mode counterforce lamp must go out;

-- throw the flight-mode counterforce switch to the "on" position so that the signal lamp lights up;

-- extend the flaps to flight position. Check the flap deflection angle by the flap position indicator and ascertain by the communicator's report that the flight leader lamp is out;

-- retract the flaps; the flight-mode counterforce lamp must again light up.

6. Check the spoiler deflection and make sure that the spoilers on the left and right wings are deflected up to the full angle. Retract

2-49 4357 the spoilers and check the working order of their signal system.

7. Switch on the DR-134M yaw damper by observing the following sequence:

WARNING: Traverse the rudder 4-5 complete swings with the GU-108D hydraulic booster engaged each time before switching on the DR-134M.

-- set the control switches (channels 1 and 2) to "operate." The green lamps must illuminate on the PBK-134B (alignment and yaw damper monitor panel);

-- check the neutral position of the extension rods of the first and second channels using the visual indicators on the PBK-134B. The meter needle must stand in the neutral position;

-- check to see that the adjustment controls of the transmitting frequencies "ω_x" and "ω_y" on the PBK-134B are opposite the white marks.

8. Check the DR-13kB yaw damper operation using the PMK-13kB panel:

-- uncover the ground switches "ω_x" and "ω_y";

--depress the "ω_y" switch to the right.

Thereupon the needles of the first and second channel indicators at first are deflected to the left (rudder to the right), after which they return to the neutral position.

When the switch is released the meter needles and the rudder are deflected to the opposite side.

-- depress the "ω_x" switch to the right. This causes the meter needles to be deflected to the right index and the rudder is deflected to the left;

-- depress the "ω_x" to the left; the meter needles are deflected to the left, but the rudder deflects to the right.

When the switch is released the meters and the rudder return to their neutral position.

During normal yaw operation cover the switches with the caps and switch off the yaw damper.

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11. HIGH-ALTITUDE EQUIPMENT

The following indicators are monitored in the pressurized cabin:

-- barometric pressure;

-- pressure differential between the cabin and atmosphere;

-- rate of change in cabin [equivalent] altitude;

-- air supply

-- cabin temperature in the ventilation system.

These factors demand constant monitoring when the high-altitude system is operating on the ground and in the air, and it is further essential to observe the established order of system component switch-on.

The temperature control in the crew cabin and ventilation system is either automatic or manual, and is regulated by a manual mechanical device.

1. Prior to engine start-up check the following:

(1) On the right AZS (automatic circuit protection) panel the following automatic protection devices are switched on: "Cabin pressurization, left and right engine", "Automatic", "ARTV TKh" (automatic ventilation temperature control of the pipe-element cooler), "ARTV VVR" (automatic ventilation temperature control of the radiator), "Crew cabin automatic temperature control, fwd and aft", "Thermometer TUE-48", "TV-19, TUV-15 Thermometer", "Ground ventilation, flight ventilation";

(2) "Cabin pressurization" switches are set to off (neutral); see figure 2.9;

(3) "Pressure Loss" switch to off (neutral);

(4) valve switches for by-passing air past the radiator and pipe-element cooler ("Ventilation VVR and TKh") are located in the "automatic" position, cabin heater cocks in the neutral position (after holding 20-30 seconds in the "cool" position to completely close the baffles), and the automatic device supply switch to the "on" position;

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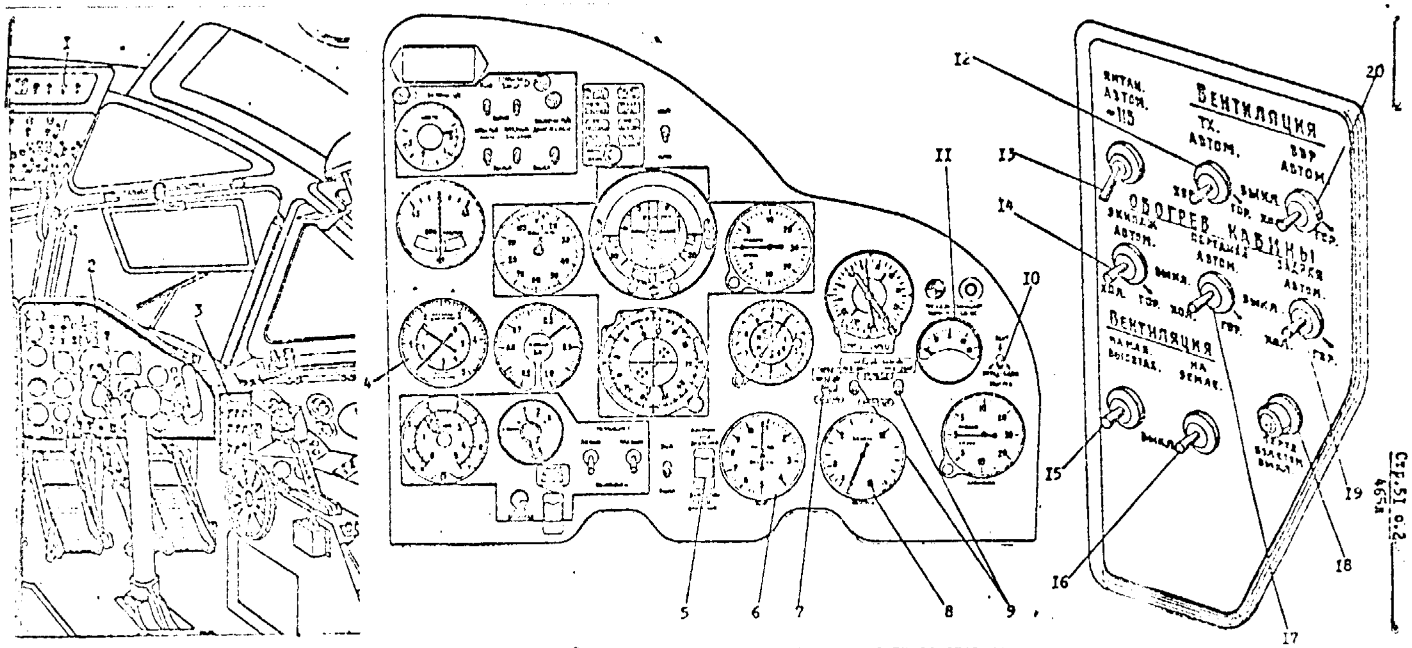

Figure 2.3 High Altitude System Controls

1. [illegible] switch for the navigator's and pilots' window defrosters
2. Copilot instrument panel
3. [illegible] system control
4. [illegible] and cabin [illegible] indicator
5. Cabin [illegible] switch
6. [illegible] system airflow indicator [illegible]
7. [illegible] for cabin [illegible]
8. [illegible] heater system air-flow indicator
9. [illegible] control switch for [illegible]
10. [illegible] switch of the TUE-48 temperature indicator
11. [illegible] system [illegible]
12. [illegible] control switch for [illegible]
13. [illegible] supply [illegible]
14. [illegible] control switch for [illegible]
15. PPNG-15K low altitude ventilation control switch
16. PPNG-15K control for on-the-ground ventilation when engines are operating
17. [illegible] control switch for [illegible] distributor
18. [illegible] output channel [illegible] red signal [illegible]
19. [illegible] control [illegible] air distributor
20. [illegible] control [illegible] TVR [illegible]

(5) "Ground ventil[illegible]" and "Low-altitude venti[illegible]" switches are set to the "close" position;

(6) the three-way cock on the master instrument [illegible] set to the "on" position, and an auxiliary pressure of 0.57 kg/cm² is established, the rate of pressure change is 0.18 [illegible], and the pressure at the start of cabin pressurization at [illegible] mercury is less than the pressure prevailing at the a[illegible] time of take-off.

2. Checking the working order of the pre[illegible] conditioning systems on the ground is performed [illegible] in the 82-87 per cent mode with a standard [illegible] graph during flight preparation.

Systems checkout is performed in the [illegible]:

-- set the "Ground ventilation" switch [illegible];

2-52 465L -- set the "TKh and VVR ventilation" switch [illegible] position until the valves are completely [illegible]. [illegible] time for the baffles is 20-50 seconds. [illegible]

-- switch on the air supply by setting [illegible]" switch to the "increased flow" position [illegible] the ventilation system with the flow meter. [illegible] ture of the air supply more than 60°;

-- switch on the crew cabin heater [illegible] the air supply in the heater line. Switch [illegible] check.

NOTE: Carefully check the temperature [illegible] heater system. Do not [illegible] appearance of a specific [illegible] line.

3. When operating the aircraft during the hot time of the year do the following:

(1) Cool the cabin before landing. The conditioner is disconnected before the engines are started up or when the aircraft is being towed.

(2) After starting engines switch on the air supply in the ventilation line according to the instruction in section 2. The air flow must be 2.5-3 units*, and the temperature 10 to 25° C.

Immediately before take-off the air supply must be switched off, during which the red warning lamp "Switch off before take-off" must be out.

(3) After taking off, switch on the air supply from the ventilation line in short increments at altitudes of 300-600 m. During this the cabin variometer must not show a rate-of-change in excess of 2 M/sec and the air flow must be 2.5 to 4 units in the cruise mode.

After the air supply is switched on, set the cabin pressure to 760 mm Hg by smoothly changing the "Start Pressurization." On the other hand, the altitude at which the normal auxiliary pressure of 0.57 kg/cm^2 is reached in the cabin will depend upon the pressure at the start of pressurization, which was set before take-off and may swing in a range of 5.4 to 12 km when setting the control to correspond to 800 and 567 mm of mercury (see Figure 2.10).

(4) In order to lower the high cabin take-off temperatures to the normal value of 20°, it is necessary manually to maintain a low temperature in the ventilation system, but no lower than 10°. Monitor

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*Value of 1 unit is 700 kg/hour.

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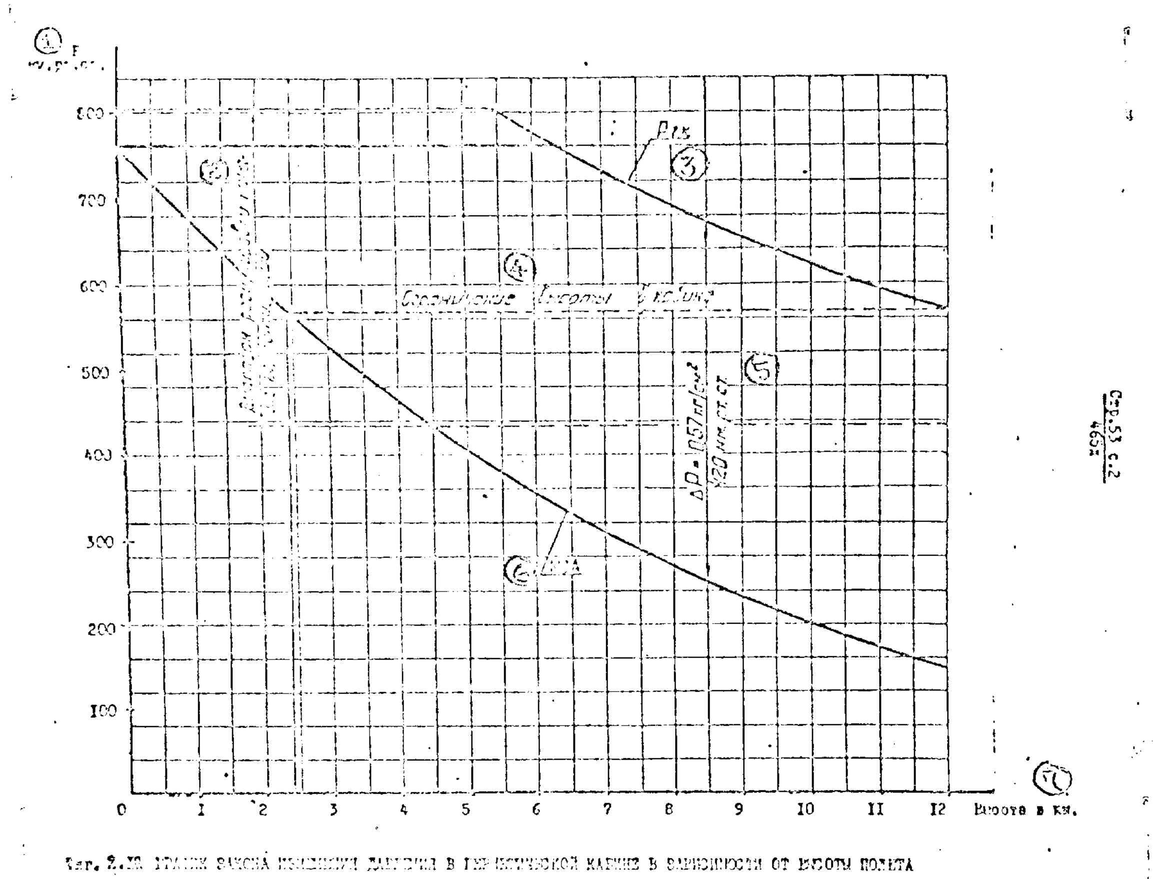

Figure 2-10. Graph of pressure change in a pressurized cabin in relation to flight altitude.

1. Pressure in millimeters of mercury

2. Range of start-pressurization control

3. Cabin pressure

4. Limit of cabin [equivalent] altitude

5. P=0.57 kg/cm^2
420 mm Hg

6. International Standard Altitude

7. Altitude in kilometers

it with the thermometer.

(5) When lowering the temperature in the cabin to 20-22°C, switch to automatic temperature control in the ventilation system by setting the "Ventilation TKh and VVR" switches to automatic and the temperature control to 18-20°C.

2-54 4651 (6) When it is necessary to switch to manual temperature control of the ventilation system, the automatic system power supply should be switched off. Meanwhile, to increase the temperature, increase the air past the TKh and afterwards past the VVR by setting their switches to the "hot" position.

To decrease the temperature of the air supply, first set the VVR switch to the "cold" position and then the TKh switch to the "cold" position.

(7) Use the "Crew cabin heater" switch to increase the temperature in the crew cabin. When condensation forms on the crew cabin windows, switch on the corresponding switch.

(8) During a landing approach, while still at an altitude of 300-600 m, switch off the cabin-pressurization and automatic system. Switch on the ground ventilation in accordance with point 2 after touchdown and during a long taxi.

4. When operating the aircraft in the cold time of the year do the following:

(1) Before boarding passengers warm the cabins to ±15° using the airport conditioner.

(2) Check to see that the selector and on-off switches are in

the positions indicated in point 1 and, in addition, switch off the TGh by setting its switch to the "hot" position.

(3) After starting up the engines, switch on the ventilation air supply in accordance with point 2. The supplied air temperature must not exceed 60°C. Switch off the air supply before take-off.

(4) After take-off and at an altitude of 300-600 m switch on (in short increments) the ventilation line air supply from the engines, and maintain a temperature of 40-60° with the "VVR ventilation" switch. Gradually, manually switch on the cabin heaters. Meanwhile, carefully regulate the temperature of the air supply in the heater line.

WARNING: It is forbidden to increase the temperature more than 70°. When a specific odor is detected, immediately switch off the passenger cabin heater line. The passenger cabin heater cannot be switched to automatic.

(5) When increasing the cabin temperature to 20°C set the temperature control to 20-22° or maintain it manually.

(6) The air flow at the cruising altitude must be 2.5-4 units in the ventilation system and 3-6 units* in the heater system.

(7) Switch off the cabin pressurization at an altitude of 300-600 m when descending for a landing.

5. In flight with passengers the altitude rate of change in the pressurized cabin must not exceed 2-3 m/second when changing the aircraft altitude and engine operating mode.

When the aircraft is descending at various descent velocities, the cabin descent rate indicated above is provided for automatically.

*The value of 1 unit in the heater system is 105-155 kg/hr.

6. An auxilliary cabin pressure of 0.57 ± 0.02 kg/cm^2 must be automaticelly maintained when the "Start Pressurization" control is set to 700 mm Hg at altitudes greater than $6250 {}^{-600}_{+700}$ m.

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7. When setting the "Auxilliary pressurization" control to 0.57 kg/cm^2 and "Start Pressurization" control to 760 mm Hg, the cabin barometric altitude must agree with the values indicated in the table below:

Pressure Drop kg/cm^2	mm mercury	Flight Altitude, M								
		5000	6000	7000	8000	9000	10000	11000	12000	13000
0.5	367.7	0	435	931	1493	1972	2417	2827	3393	3526
0.57	419.2	0	0	371	853	1302	1717	2098	2443	2746

8. Before starting the landing descent, and at an altitude no lower than 6250 m, set the "Start Pressurization" control to the airport barometric pressure.

When regulating the control below 6250 m, the control should be changed slowly without permitting the cabin variometer needle to deflect more than 3m/sec. Later on, during constant pressure change, the control may be changed more vigorously.

9. During continuous descent of the aircraft from the crusing altitude, at a descent velocity of 8-10 m/sec, the auxiliary cabin pressure drops smoothly. Thus the pressure drops from 0.57 to 0.44-0.48 kg/cm^2 at 6250 m, which is acceptable and explained by the circumstance that the cabin-interior descent rate is limited during the descent of the aircraft (to a value not more than 2-3 m/sec).

10. Special flight events. (1) When the auxiliary pressure (pressure differential between cabin and atmosphere) exceeds the permissable 0.63 kg/cm^2, a red warning lamp on the copilot's instrument panel lights up and an intermittent audio alarm sounds.

In this case it is necessary to cut off the cabin pressurization, drop the aircraft to a safe altitude and land at the nearest airport.

(2) It is necessary to perform an additional descent of the aircraft to a safe altitude when the yellow "Depressurization" warning lamp lights up or when the audible alarm sounds and a real pressure drop in the cabin is determined by the UVPD-5K indicator.

(3) In the event a forced landing away from an airport becomes necessary, switch off the pressure and depressurize the cabin to an altitude of 1500 m above the prospective landing spot.

(4) When necessary to quickly abandon the aircraft in an emergency after landing, throw on the "drop pressure" switch to open the doors and hatches without hindrance.

It is forbidden to use the "drop pressure" switch in flight with passengers aboard.

2-56 and 2-57 463L (5) Shut off the air supply from the compressor of the defective engine during an engine fire or the appearance of smoke and a specific odor from the ventilation and heat vents.

12. OXYGEN EQUIPMENT

2-58 438L Stationary oxygen equipment is installed aboard the aircraft for the crew members with KP-24M oxygen equipment at each crew cabin seat.

The stationary system is provided with a 92-liter tank of oxygen at a pressure of 30 kg/cm^2. This oxygen reserve provides one crewman a a supply of oxygen for an entire flight, and the other crew members for one hour of flight.

To use the KP-24M oxygen unit, open the instrument valve cock. The MK-13M manometer located on the trimmer panel must indicate the actual oxygen pressure in the on-board tank, i.e., the on-board reserve of oxygen. The flexible mask-hose is connected with the respiratory hose of the KP-24M unit. Put mask to face. The operation of the unit is monitored by the movement of the "IP" indicator vanes during inhalation and exhalation through the mask.

In a normal flight with an overpressurized cabin the air inflow switch on the KP-24M instrument must be set to the "mix" position.

During difficult breathing or illness the emergency oxygen supply should be used. Turn the valve handle of the "emergency supply" cock to "open". It is necessary to remember that the emergency oxygen discharge is significantly greater than the established norm.

WARNING: A peculiarity of the KP-24M unit is that it may continue to supply a continuous stream of oxygen after the mask is removed from the face. This occurs because a discharge from the oxygen passing through the ejector is formed under the automatic oxygen apparatus membrane. To prevent oxygen from escaping, exhale into the mask before removing it from the face or cover the opening with the hand for some time. In flight it is necessary to periodically monitor the operation of the KP-24M equipment by the "IP" indicator and the pressure with the manometer.

2-59
435L After using the oxygen equipment, remove the mask from the face, wipe the inside of the mask and place it inside the bag. Cover the equipment valve.

In addition to the aircraft oxygen equipment, the plane has portable oxygen equipment. The portable KP-21 oxygen apparatus is intended for passengers in poor health, or during bad flying conditions. An open-type KP-16M mask is used with the KP-21 apparatus. The KP-21 is equipped with a light tank which contains a reserve of oxygen under 30 kg/cm^2 pressure. A 1.8-liter tank lasts 12-15 minutes.

To use the portable KP-21 apparatus, turn the valve counterclockwise and check the manometer for the presence of oxygen. Take the metal mask-hose connector, insert it into the apparatus nipple and turn it to fasten it to the stem. Place the mask to the face (cover the nose and mouth) and fasten it to the head with the fastening band. Switch on the oxygen supply by turning the regulator-valve handle 1/4-1/2 turn counterclockwise.

When the oxygen in the tank is used up (pressure in tank is 3 kg/cm^2 by the manometer) close the valve, remove the mask and set the apparatus back in place.

For crew-members use, one type KP-19 portable oxygen apparatus, having a 7.8 liter tank capacity and a KM-16M mask, is installed in the front crew locker. This apparatus is similiar in design to the KP-24M. The KP-19 apparatuses use oxygen under 30/cm^2 pressure.

The use-duration of the instrument is 35-40 minutes.

NOTE: Unless absolutely unavoidable, the portable oxygen respirator must never be charged from the stationary aircraft oxygen system.

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13. RADIO EQUIPMENT

Aircraft Radio Communications, Radio Navigation and Radar Equipment

A. RADIO COMMUNICATIONS EQUIPMENT

The airplane's radio communications equipment consists of:

-- aircraft intercom equipment type SPU-7;

-- aircraft public address system type SGU-15;

-- two LOTOS command radio sets type RSB-70;

-- MIKRON communications radio set; and

-- an emergency radio set.

Intercom and Public Address System

1. The aircraft's intercom system provides:

-- telephone communications between crew members;

-- use by the crew of communications and command radio sets for reception and transmission;

-- monitoring of signals from ground navigation and landing beacons;

-- telephone communications between the crew and the technical personnel when the airplane is parked; and

-- monitoring by the captain of the dangerous altitude signals provided by the RV-4 (RV-UM) radio altimeter.

2. The aircraft's public address system makes possible:

-- loudspeaker announcements to the passengers by the captain and the steward;

-- telephone communications between the captain and the steward;

and

-- loudspeaker reception in the pilots' and navigator's compartments of all conversations conducted through the captain's intercom set.

3. Before initiating communications (either external or within the airplane), place the intercom-radio selector switch on all the sets in the radio position and the switch labeled "Passengers, Intercom, On-board Reception" (PASS-SPU-BP) in the intercom position.

4. For communications between the pilots and the navigator, the central-call (TsV) button on the intercom set is used.

<u>NOTE</u>: If the central-call button generates interference when conducting communications, use the intercom position of the intercom-radio selector switch on the intercom sets and the foot switch or the control-yoke intercom buttons.

The control-yoke intercom buttons should be used for communications between the pilots.

-61 469L) 5. The captain's announcements to the passengers over the intercom system is accomplished with the DEMSh-1 microphone with the selector on the captain's intercom board in the passenger position. After the announcement, the selector should be switched to the intercom position.

Announcements by the steward are accomplished only by pressing the DEMSh-1 microphone button.

<u>The LOTOS and RSIU-5GM Command Radio Sets</u>

1. The crew and the escort pilot can maintain external radio communications by using the Lotos and RSIU-5GM command radio sets. The radio set is switched on by the captain.

2. The captain and the navigator can select from the PU-2 remote control panels the specified working frequency, the receiver passband,

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and the loudness adjustment as well as turn on the squelch control.

The escort pilot and the copilot can maintain communications only after the captain and the navigator ready the radio set for operation.

3. For the crew members to use the command radio sets, the selector on the captain's set must be placed in the "KR" or "UKR" position (at radio sets 1 or 2); and the intercom-radio selector, in the radio position. This will make reception possible.

4. For transmission from the AG-2 headgear microphone, the pilots must press the control-yoke radio button; and the navigator, the foot slide switch.

For the escort pilot to have reception, the internal-radio selector switch on the captain's set must be placed in the radio position; and the radio communications selector in the IHF-1 or IHF-2 position.

To transmit, the escort pilot has only to press the manual slide switch.

5. Radio set 1 must be used for communications when the airplane is parked or taxied and when it prepares to land or takes off. In this case, the navigator should ready radio set 2 as stand-by equipment.

When on the flight course, radio sets 1 and 2 should be used alternately for 40 minutes each.

WARNING: a) When the UHF transmitter of radio sets 1 and 2 and the KURS-MP equipment in the landing mode are operated simultaneously, and if the UHF working frequency resonance of the radio set and the course receiver is less than 0.3 MHz and if there is interference for the KURS-MP equipment, the blinker will be knocked out and the course strip of the PKP-4 instrument will drift 1.5 marks. In this case transmission over the UHF radio should be only in cases of extreme necessity and of short duration;

b) Simultaneous operation of both sets, one receiving and the other transmitting, without interference is possible only when the station working-frequency separation is greater than 0.7 MHz.

(2-62 465L) The 1-RSB-70* Communications Radio

1. The copilot operates the radio set. There are provisions making it possible for the navigator to operate the set; however, the transmitter and receiver control panels must be transferred from the copilot to the navigator.

2. The captain and the escort pilot can use the radio set for communications only when it is first prepared for operation by the navigator or the copilot.

3. To prepare the communications radio for use, the copilot or the navigator must proceed as follows:

-- place the local-distant selector switch on the I-RSB-70 transmitter front panel in the distant position; and the calibration-tuning-operation selector, in the operation position;

-- set the selector on the captain's intercom set to the SR position; and the intercom-radio selector, to the radio position;

-- place the mode selector on the remote control panel in the telephone position and turn on the transmitter;

-- set the channel selector on the remote control panel to the working frequency, the signal lamp will light after the automatic tuning is completed; and

-- tune the US-8 receiver to the operating frequency and listen to the signals from the ground radio station.

4. For transmission from the AG-2 microphone, the pilots must press the control-yoke radio button; and the navigator, the foot switch. For reception, the escort pilot must place the selector on the captain's intercom set in the RS (liaison) and radio positions; the receiver should then come through the earphones.

Press the remote button to switch from reception to transmission.

5. The operation of the transmitter may be monitored by means of self-monitoring when the copilot places the self-monitoring, LF (NCh), HF (VCh) switch in the LF and HF positions.

WARNING: In a number of frequencies in the short-wave band, the R-807 transmitter will interfere with reception on the UHF radio and the KURS-MP equipment, errors in the readings of the radio compass will be observed, reception of call signs on the ARK and reception on the UHF radio set will be disrupted, the blinker will operate, and the course strip of the NKP-4 instrument will drift. Therefore to operate the above-mentioned instruments without interference, do not turn on the R-807 transmitter.

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*Commencing with series III (in 1968), the MIKRON communications radio will be installed on the aircraft.

(2-63 435L) Aircraft Emergency Radio

The purpose of this radio set is to summon rescue aircraft and to guide them to the airplane (or crew) which had the accident.

The radio set provides:

-- automatic transmission of distress and call signals, and

-- transmission and reception of CW and voice signals with the headset and telegraph key.

The transmit-receive selector is used to switch from one mode of operation to the other.

A set of dry-cell batteries powers the radio.

B. RADIO NAVIGATION EQUIPMENT

The aircraft's radio navigation equipment consists of:

-- two automatic radio compasses ARK-II,

-- radio altimeter RV-UM*;

-- autopilot NAS-1A6;

-- navigation and landing system KURS-MP-2**; and

-- landing and approach navigation system RSBN-2S.

ARK-11 Automatic Radio Compass

1. The aircraft is equipped with two automatic radio compasses ARK-11 numbered 1 and 2 (main and auxiliary).

2. The navigator switches on, aligns, and operates the radio compass.

Course angle readings are provided simultaneously to the navigator and to the pilot and copilot.

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*The series III aircraft (1968) will be equipped with the Chelnok radio altimeter.

**Until provided by the industry, the KURS-MP-1 equipment will be installed temporarily.

3. In an emergency, the ARK-11 radio compass 1 and the LOTOS radio can be switched simultaneously from the on-board power supply circuit to the AC circuit of converter PO-500. The transfer is automatic when the on-board circuit is switched from the normal to the emergency mode or when the captain turns on the PO-500 manually.

4. The course angles of the radio station or the current azimuth readings of the VOR beacons are available to the navigator on the USh instrument. Pointer 1 is supplied the KUR ARKI or VOR 1 azimuth (from the first half of set KURS-MP-2); and pointer 2 is fed the DUR-ARK-2 or
(2-64) VOR-2 azimuth (from the second half of the KURS-MP-2 instrument). The ARK1-VOR1 and ARK2-VOR2 selector switches are used to connect the USh instrument to the ARK-II radio compass.

These selector switches at the same time switch the earphone outputs of the radio compass and both halves of the KURS-MP-2 to the navigator's intercom set.

5. For the pilots, the course angles of the radio set and VOR beacons are displayed on the two-pointer RMI radio magnetic indicators. The narrow pointer of the RMI is fed the KUR ARK-1 or VOR-1 signal (from the first half of KURS-MP-2), and the wide pointer is supplied the signal from the KUR ARK-2 or VOR-2 (from the second half of KURS-MP-2). The KUR is read from the outer scale, and the current magnetic course and azimuth of VOR beacons from the inside scale (the course opposite the fixed index, and azimuth opposite the pointers).

The selector switches on the front of the instrument are used to connect the RMI instrument to the radio compass ARK-II or to the KURS-MP-2 sets; the switch indications are labeled "ARK1-ARK2" and "VOR 1-VOR 2" and are located in the windows next to the selectors.

The same selectors simultaneously switch the headphone outputs of the radio compasses and the KURS-MP-2 sets into the pilots' intercom sets.

6. The crews' headsets are connected to the radio compass outputs for the purpose of hearing the signals from the ground facilities by placing the radio communications selectors on the intercom set in the RK1 (ARK1 and VOR-1) and RK2 (ARK2 and VOR-2) positions.

RV-UM Low-Altitude Radio Altimeter *

1. Only the captain may turn on and use the altimeter.

2. To ready the altimeter for operation proceed as follows:

-- turn on the power supply; in 3-4 minutes, the altimeter pointer should settle on the zero mark of the scale with an accuracy of ±5 meters; and

-- set the altitude signal selector at K, and then at any other position except off. An intermittent 400-Hz tone should be heard in the captain's earphones for 3-10 seconds, and the display "Dangerous Altitude" should blink on and off on the light register on the pilots' middle instrument panel.

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*The Chelnok radio altimeter will be installed on series III aircraft (in 1968)

3. The use of the RV-UM radio altimeter makes it possible to determine the actual altitude (0-600 meters) over the overflown terrain and to ascertain the moment the aircraft drops to a preset "dangerous" altitude (selected by the PSV-UM switch) from the intermittent pulse in the captain's earphones and the crew's intercom loudspeakers and from the blinking of the dangerous-altitude light register.

(2-65) WARNING: The radio altimeter must not be recalibrated during flight.

KURS-MP-2 Navigation and Landing System

a) System Preflight Preparation

1. The first half set of the system is operated from the pilot's seat and the second from the copilot's. Visual and aural indications of the call beacons of the VOR and ILS systems are provided for both pilots. The navigator has provisions for monitoring navigation using instruments KPP-MS and USh and by listening to the VOR and ILS ground call beacons.

2. To turn on the KURS-MP-2 system proceed as follows:

-- check if the circuit breakers of both halves of the KURS-MP-2 system, the PUT'-4MPA system, the TsGV-4 vertical gyroscope, and the KURS-MP-2 signaling system are on;

-- turn on the PUT'-4MPA system and the TsGV-4 vertical gyroscope;

-- turn on both halves to the KURS-MP-2 system; and

-- set the PRR on the radio systems selector in the required position.

Readiness of both halves of the system for operation in the navigation mode is indicated by the red signal course lamps (labeled "K") going out and by the closing of the white course blinkers on the NKP-4 instruments.

Readiness of both halves of the system for operation in the landing mode is indicated by the red signal course lamps (labeled "K") and the green glide-path (labeled "G") lamps on the radio systems selector (left one on the first half of the system and the right on the second half) going out and by the closing of the white course and yellow glide-path blinkers on instrument NKP-4. Transfer from the main (first) half set of the system to the stand-by (second) set will occur automatically when the selector is in the I or RSBN/SP-50 positions.

b) Flying Aircraft by VOR System

4. To use the main set in this mode proceed as follows:

-- set the PRR on the radio system selector in position 1,

-- select the VOR beacon working channel on the control units of both KURS-MP-2 units;

-- set the radio communications selector on the intercom set at the PKI position;

-- position the selector on the PMI at VOR-1 and VOR-2 and listen to the call beacons;

-- locate the marker selector on the radio system selector in the route (Marshr.) position; and

-- set the required azimuth (the magnetic course) on the azimuth selector.

(2-66 435L) Lighting of the red K1 lamp on the radio systems selector indicates that the course channel of the first set of the system is defective and the need to switch over to the second set.

5. To use the second halve of the system proceed as follows:

-- place the PRR on the radio systems selector in position 2, and

-- position the radio communications switch on the intercom set at RK2.

6. To come out on the given azimuth line along a smooth curve, using the wheel and pinion, set the course pointer on instrument NKP-4 to the specified azimuth (magnetic course) and disconnect the CHU on the FU-16 AP-6YeM-3P placing it in the ready ("Podg.") position.

WARNING: In the PRR positions 1 and 2 on the radio systems selector, the specified course pointer on both NKP-4's must be set simultaneously to the course angle or else discrepancies in the deflection of the command pointers will occur.

During semiautomatic control of the aircraft, by yawing, position the vertical command pointer at zero (the center of the PP-1PM instrument) in order to come out on the given azimuth line. In the turning process, by changing the yaw, hold the pointer at zero. The aircraft will then come out on the given azimuth line along a smooth curve, and then will follow this line. During automatic control, press the course (Kurs) lamp-button and the autopilot will perform the above-mentioned operation to bring the aircraft to the specified azimuth. The drift angle will be computed automatically by the PUT'-4MPA system. The horizontal command pointer will be in the upper section of the PP-1PM instrument (separated pointers mode) and is not used for piloting.

7. The position of the specified azimuth line relative to the aircraft is determined by the position of the vertical NKP-4 strip in relation to the center of the instrument.

8. When the airplane is flown in the same direction after passing the

beacon, the azimuth on the azimuth selector will not change. The 180° change of course on the RMI instrument and the extinguishing of the "TO" display and the lighting of the "FROM" display on the selector idicates that the aircraft has passed the beacon.

c) Landing by the ILS System

9. To use this mode proceed as follows:

-- set the PRR on the radio systems selector to position 1,

-- place the ILS-SP-50 selector switch at ILS,

-- select the working channels of the ILS beacons on the control uuits of both sets,

-- position the radio communication selector switch on the intercom set at RKU,

-- locate the selectors on the RMI in the VOR-1 and VOR-2 positions and listen to the ILS beacon signals, and

(2-67 435L) -- put the marker selector in the landing (posadka) position.

10. To complete the swing to the landing path with the vertical command pointer of instrument PP-1PM, set the specified path pointer of the NKP-4 to the landing path value and disconnect the STU on the control panel of the PU-16 AP-6Yem-ZP by placing it in the stand-by (podg.) position.

11. With automatic control, press the course (kurs) button; and, with semiautomatic control of the aircraft, complete the swing to the landing path by yawing the vertical command pointer PP-1PM to the center of the instrument. The command to start the swing to the landing path is usually given from the ground. Pullout in the axial plane VPP is indicated by the arrival of the NKP-4 vertical position strip in the center of the instrument; a

of the specified course pointer, under the fixed index of the course reading ±US (drift angle).

The swing to the landing course and the flight on this course to the entry into the glide path is done using the horizon with level flight.

During semiautomatic flight, when the glide strip approaches zero, change the pitch of the aircraft to bring the horizontal command pointer PP-IPM to the center of the instrument; during automatic flight, press the glide (glissada) light button. During semiautomatic control, holding both command pointers in the center of the instrument, the flight must be on course and on the glide path until emergence from the clouds; then transfer to visual flight and land.

If the airplane has descended to the safe altitude established for the given airport but has not emerged from the clouds, recircle the airport and follow the directions of the air traffic controller. On descending to an altitude of 50 meters with automatic control, tilt the descend-climb (spusk-pod"yem) levers to bring the system into the extended glide path mode or turn off the autopilot and assume semiautomatic control.

12. A fault in the course channels and glide paths of the KURS-MP-2 systems is indicated by the lighting of signal lamps K1 and G1 and K2 and G2 on the radio systems selector. If the course channel (glide path) instruments of the first system break down, facilities for automatic switching to the corresponding channel of the second system are provided.

13. The range to the runway is monitored by the lighting of the marker signal lamps: blue for 7,400 meters, yellow for 1,050 meters, and white for 75 meters. Lighting of the lamps is backed up by a bell.

d) Landing Approach with Simultaneous Use of VOR and ILS Systems

14. This landing approach method is used when, during the approach to the airport on a specified azimuth (magnetic course) using
(2-68) the VOR beacon, the aircraft crosses the ILS line.

15. Before the landing approach, the following must be done:

-- when flying according to the VOR beacon azimuth, before entering the ILS course beacon zone, switch the PRR switch on the radio systems selector from position I to joint (sovm);

-- set the ILS-SP-50 selector switch in the ILS position;

-- select the working channel of the ILS beacons on the control unit of the second set of the system;

-- place the marker selector in the landing (posadka) position;

-- set the specified course pointer on the copilot's NKP-4 to the landing course value; and

-- position the KPP navigator-NKP pilot switch to the NKP pilot position.

16. Using the PP-1PM instruments of both pilots and the NKP-4 instrument of the pilot, continue the flight on the specified azimuth of the VOR beacon, and on the copilot's NKP-4 instrument monitor the moment when the aircraft enters the equal signal zone of the ILS course beacon.

17. On entering the equal signal zone of the ILS course beacon (the moment of entry is indicated by the deflection of the copilot's NKP-4 vertical position strip), swing the aircraft, using the copilot's NKP-4 and the gyrohorizon, onto the landing course or onto the return course depending on the distance of the airplane from the airport and the flight altitude at

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the moment of entry into the zone.

18. In the first case, when the copilot completes the swing to the landing course, the pilot must: select, on the control unit of the first set, the ILS beacons working channel; set, on the NKP-4, the specified course pointer to the landing course value; switch the PRR, on the radio systems selector, from the joint position to position 1; and begin piloting the aircraft by the method presented in steps 11-13 of the section titled "Landing by the ILS System."

WARNING: 1. Switch the PRR from the joint position to position 1 after placing , on the NKP-4, the return course pointer to the landing course value; otherwise there will be a discrepancy in the readings of the command pointers.

2. Switch on the course (kurs) light button after bringing the aircraft from the swing to the landing course.

In the other case, when swinging to the return course, leave the PRR in the joint position on the radio systems selector until the start of the standard swing to the landing course.

Use the gyro-horizon and the vertical position strip of the copilot's NKP-4 instrument to fly on the return course. Remember that in this case the vertical position strip of the NKP-4 gives a reverse reading. To come out in the runway axial plane the swing must be in the direction opposite to the deflection of the strip.

(2-69 465L) The starting point of the standard swing is determined from the given value of the current azimuth of the VOR beacon on the RMI [radio beacon instrument]. This value is read from the inside scale of the narrow

VOR-1 pointer.

In the process of making the standard swing, the copilot performs for the captain the same operations as in the swing to the landing course described in the first case.

19. After entry into the landing course, the aircraft is flown according to the method described in steps 11-13 of the section titled "Landing by the ILS System."

c) Landing Approach With the SP-50 and Put'-4MP Systems

20. To use this mode proceed as follows:

-- place the FRR on the radio systems selector in position I,

-- switch the ILS-SP-50 selector to the SP-50 position,

-- select the working channel of the SP-50 beacons on the control units of both sets;

-- put the selector on the RMI in the ARK1 and ARK2 position and listen to the call signals of the homing radio station, and

-- locate the marker selector in the landing position.

21. Extinguishment of the K1, G1, K2, and G2 signal lamps on the radio systems selector signals that the course channel and the glide path of the KUS-MP-2 sets are ready for operation.

Should the course (glide path) channel breakdown in the first half of the system, automatic switching-on of the corresponding channel of the second half of the system is provided.

22. To swing to the landing course using the command pointer, use the rack and pinion to set the given course pointer on the NKP to the

the value of the landing course and place the STU selector switch on the PU-16 AP-6YeM-ZP control panel to the ready (podg.) position.

23. During a landing approach with a rectangular route ("Big Box"), perform the first, second and third swings with the gyro-horizon and the NKP, and the fourth as well as the landing trajectory with the command pointers of the PP-IPM instrument. Determine the start of the swings from the course angles of the DPRM (KUR) on the RMI or from the navigator's command taking the drift angle into account. Perform the second and third swings with the KUR = 240°, and the fourth with KUR = 290°.

Determine when to bring the aircraft out of the first, second and third swings by the specified course pointer on the NKP instrument as it approaches the corresponding triangular indexes.

(2-70 455L) 24. During the flight from the radio station traverse to the start of the fourth swing make sure that the course channel is in good working order. A closed blinker on the NKP instrument (top) indicates the good condition of the channel. Then check the electrical balance of the vertical position strip of instruments NKP.

This is done by pressing alternately the I and P potentiometers on the electrical balance unit CN-50. If the strip does not settle in the center of the instrument, then center it by rotating the pressed button to the right or left.

WARNING: The potentiometer button may only be rotated when the course blinker is closed, i.e., when the airplane is in the effective range of the course beacon.

During level flight, use rack-&-pinion to bring the plane's markers in coincidence with the gyro-horizon on the PP-IFM instruments.

Before beginning the third swing, turn on the command pointer selector. Make sure than the two Put'-4MP sets are working.

25. Determine the start of the fourth swing with the automatic radio compass from the estimated radio course angle of the outer marker beacon or from the dispatcher responsible for the landing of the airplane.

NOTE: The third swing should be performed in such a way so that at the start of the fourth swing the aircraft is at least 12-13 km from the landing strip because if it is closer the Put'-4MP system cannot make it possible for the airplane to assume the specified path line in time.

Bank the aircraft in the direction of deviation of the command pointer to bring the pointer to the zero position. Banking should not be greater than 18-20°.

Then with a slight inclination of the control yoke hold the command pointer within the center ring. The aircraft should not be brought out of the bank prematurely. A deviation of the pointer from the center for a long time, even by a small amount, will result in an error in bringing the aircraft to the equal signal course zone line. However, the pointer may fluctuate within the black ring.

In case of an early fourth swing, bring the aircraft to the equal singal course zone in two steps: first, swing the aircraft 60° from the course perpendicular to the landing course and approach the predicted track at a 30° angle without banking (the course strip on the NKP-4 will be deflected). Then as soon as the course pointer on the NKP-4 is deflected, the pull-out angle will begin diminishing to zero, and the aircraft will smoothly enter the equal signal zone line of the localizer.

When the start of the fourth swing is very late, the aircraft will cross the course zone axis (the course strip on the NKP-4 will cross the center of the center ring and will go off scale), swing the aircraft 120° and without banking approach the predicted track an a 30° angle from the other side. From the moment the course strip is deflected on the NKP-4, the aircraft approach angle gradually diminishes to zero, and the aircraft

(2-71 K651) will smoothly enter the equal signal zone line of the localizer.

26. After the fourth swing and entry into the radio beacon course zone, the flight should be without descent.

The moment the aircraft enters the glide path of the radio beacon, the glide path blinker on the NKP-4 should close, and the glide path position pointer should be in the extreme top position. As the aircraft approaches the equal signal zone of the glide beacon, the position pointer of the NKP-4 should descent and approach the null position.

As the glide path position strip on the NKP-4 approaches the null index, begin the descent on the glide path and with a smooth movement of the control yoke bring the glide path command pointer on the PP-IFM to the zero position. Hold the command pointer within the central ring with small movement of the control yoke in the direction of deflection of the command pointer. The vertical speed at the moment of acquisition of the glide path is somewhat higher than during the subsequent descent.

27. On passing the outer marker beacon, the aircraft crew must:

1) Make sure of the correctness of the approach and calculation to the landing, namely:

-- that, in the outer marker beacon zone, the banking necessary to bring the command course pointer to the zero position does not exceed 5-7°; and

-- that the deviation of the course zone strips on the NKP-4 does not exceed the second point.

2) Ascertain the possibility of descent along the glide path, i.e., if the flight altitude corresponds to (the glide path zone strip on the NKP-4 is close to zero) or exceeds (its position is up to the second bottom point) the established altitude for the given airport, then continue piloting along the glide path; but, if before the outer beacon marker, the flight is below the established altitude for the given airport, do not continue the descent using the command pointers, and the crew must at once switch over to the use of the glide path strips of instrument NKP-4 and descend according to the landing dispatcher's orders.

3) Pay special attention to piloting the aircraft and hold the command pointers within the limits of the central ring using small movements of the yokes after passing the outer beacon marker taking into account the reduction of the linear width of the course zone and glide path.

4) Switch to visual flight and land after spotting the ground (landing lights).

5) Do not lower the aircraft on the glide path without seeing the ground from a minimum altitude set for the weather for the given airport.

If on the flight altitude corresponding to the weather minimum established for the airport the ground (landing lights) do not become visible, pull up for another go-around.

(2-7A 465L) 28. Monitor the distance to the beginning of the runway by the lighting of the white marker signal lamp (it will light twice), sounding of the bell, and by the rotation of the radio station approach angle beacon instrument pointer through 180° when flying past the homing radio station.

RSBN-2S Landing and Approach-Navigation System

a) Functional Designation

1. The RSBN-2L landing and approach-navigation system radio equipment is intended for:

-- flight along a specified azimuth line toward and away from a beacon ("Azimuth Toward" and "Azimuth From"),

-- flight along a route not passing through the place where the beacon is installed ("SRP"),

-- piercing the cloud cover along the landing azimuth or course, and

-- landing using the Katet-S beacons.

2. The RSBN-2S system is operated from the navigator's and captain's positions. The navigator switches on the power, selects the operating mode and channel and sets up the essential data for the flight along the azimuth or in the SRP mode. The captain can only switch the operating system into the landing mode regardless of the navigation mode established by the navigator and select the landing operating channel.

3. The RSBN-2S system ground beacon call signs may be heard by placing the radio communications selector on the intercom set in the DR position.

b) Flight Along a given Azimuth to and from a Beacon

4. To fly along a specified azimuth the navigator must proceed as follows:

-- place the PRR on the control panel in the position labeled "Azimuth - Toward" ("Azimut - Na") or "Azimuth - From ("Azimut - Ot"); and

-- set the specified true azimuth bearing on the control panel selector.

The captain must:

-- place the PRR on the radio systems selector in the RSBN position.

(2-72) 5. To enter the specified azimuth line (IZA) along a smooth curve using the vertical pointers of instrument PP-IFM, proceed as follows:

-- use the control yoke to set the specified course pointer on the NKP-4 instrument to the course angle and place the STU selector switch on the BSU-SP control panel in the ready position; and

-- with semiautomatic control, perform the swing to the specified azimuth by placing the command pointer in the center of the instrument.

6. To carry out the flight in the automatic stabilization mode, press the course (KURS) light button; this will light the red lamp on the captain's PP-IFM instrument, indicating that the autopilot has been connected to one half of the system.

7. During semiautomatic control when changing the banking to make the swing, hold the vertical command pointer in the null position (in the center of the instrument). The aircraft will approach the specified azimuth line on a smooth trajectory curve, and after entry will follow it.

During automatic control, the autopilot will perform this step; and the pilots will monitor the operation by the pointer readings.

The drift angle is read automatically by the Put'-4MPA system.

The horizontal command pointer will be in the top section of the instrument (separated pointers mode) and is not used for piloting.

The specified azimuth position in relation to the aircraft is monitored by the position of the vertical strip of the NKP-4 relative to the center of the instrument.

8. Air navigation for distance is monitored on the PPDA instrument and by the lighting of the signal lamps (for 1-2 minutes before entery on the specified point the green lamp labeled "Flight Toward the Zone" will light and when flying through the given zone the red lamp labeled "Flying Through the Zone" will light). Signaling of the flight through the zone is accomplished by setting the values for the azimuth and distance of the route monitor points on the control panel. The current azimuth value is monitored on the PPDA instruments.

c) Flight in the SRP Submode over Routes not Passing Over Beacon Installations

9. For a flight along a route not passing over a beacon installation, the navigator must, after laying out the route, determine the given course angle and the azimuth of the destination point relative to the beacon and to the distance from the beacon to the target; establish the specified course angle (ZPU) and the azimuth of the destination point relative to the beacon and the distance from this point to the beacon using the proper selectors of the SRP control unit; and place the PRR switch in the SRP

position. The captain must place the PRR on the radio systems selector in the RSBP position.

10. To come out on a specified path line on a smooth curve using the PP-1PM command pointers, set the specified course pointer on the NKP-4 instruments to the given course angle.

11. Piloting and monitoring of the navigation is done according to the method presented in the section titled "Flight Along a Given Azimuth to and from a Beacon" in paragraphs 5-8.

d) Penetrating Clouds by the RSBN-2S System

12. The cloud cover may be penetrated with the following two methods:

-- to an altitude of 600 meters, using the azimuth beacon RSBN-2S placed outside the airport; and

-- using the Katet-S course beacon placed on the airport with a subsequent landing from a direct course.

Descent can begin at a distance not greater than 250 km from the beacon and at an altitude not exceeding 10,000 meters.

13. To penetrate the cloud cover toward the beacon located outside the airport, the navigator must set the airport pressure on the DV-47 altitude data unit; use the azimuth selector to set the selected descent azimuth; place the PRR switch in the azimuth-toward position; switch on the selector labeled "Cloud Penetration" ("Probivaniye oblachnosti"); and set the PRR selector on the radio systems selector in the RSBN position.

14. During automatic control, switch on the course light button. During semiautomatic control, perform the swing for entery on the cloud penetratio

trajectory. After arriving at the penetration azimuth, place the horizontal command and glide-path pointers in the center of the instrument by changing the pitch angle.

15. While descending, hold the position strips of the NKP-4 instrument and the horizontal command pointer of the PP-IFM instrument in the center by changing the bank and pitch angles. The aircraft will them follow the descent trajectory.

16. On descent to 600 meters, the flight trajectory switches to the horizontal, and at 15 km from the beacon, the command horizontal pointer and the glide-path pointer of instruments PP-1FM and NKP-4 move sharply upward to the edge. The glide-path blinker will now open.

17. To penetrate the cloud cover to the Katet-S landing course beacon, located on the airport, with a subsequent landing on a direct path, the navigator must set the airport pressure on the DV-47 data unit; switch on the selector labeled "Cloud Penetration, ON" ("Vkl. probivaniya oblachnosti"); select the operating channel on the control panel; and place the PRR switch in the landing position (this may be also performed by the pilot).

(2-74) The signal lamp labeled "Landing" ("Posadka") will now light on the pilot's and navigator's control panels.

The captain must select the landing operating channel on the panel and place the landing selector switch in the on position (or this may be done by the navigator).

The landing signal lights will light on the pilot's and navigator's control panels.

The captain must place the PRR switch on the radio systems selector in the RSBN position; the specified course pointer on the NKP-4 unit, to the landing course value; and the marker selector, in the landing position.

18. Piloting is according to the method described in steps 14-17 of of subsection d. At 14-16 km from the beginning of the runway, the signals from the glide path beacon Katet-S will NKP-4 will begin controlling the glide pointers of instruments PP-IPM and NKP-4. Switch-over from the instrument glide path computed by the aircraft's equipment to the ground beacon glide path is automatic and is signaled by the lighting of the radio-glide-path-on ("Radioglissada vklyuchena") lamp.

19. The distance to the touchdown point is indicated on the PPDA-P instrument and by signaling as the marker beacons are passed.

e) Landing by the Katet-S System

20. To land by the Katet-S system, the captain or the navigator must perform the requirements of step 17 of the subsection on cloud penetration.

21. The method described in the subsection titled "Landing by the SP-50 System" is used for performing the calculations and the approach for the landing, with the following differences:

-- switching-on of the landing mode is also signaled by the lighting of the radio-glide-path-on lamp,

-- the distance to the touchdown point is indicated on the PPDA-P instrument, and

-- the landing approach may be performed by flying a rectangular route (large box) or directly.

To make a rectangular route with the RSBN-2S beacon, it is necessary, before the flight, to determine from the chart the azimuth and the distance of the points for the start of swings 1, 2, 3, and 4 in relation to the beacon. This should be done for each airport.

Circumscribe the rectangular route in the SRP mode by entering the starting point of one of the swings of the big box or by entering any point located at a distance equal to the radius of the swing from the rectangular route.

22. Straight line landing is performed according to the method described in the subsection titled "Penetrating the Clouds on the Beacon,"(which is located at the airport) with subsequent landing on a straight line.

NOTE: The captain has the prerogative of switching the RSBN-2S into the landing mode from the pilot's panel.

(2-75) f) Landing by the SP-50 System While Using Both the RSBN-2S and KURS-MP-2 Systems

This mode is used in cases where, when approaching the airport on a specified azimuth toward or from the RSBN-2S beacon or when the route does not pass over the beacon installation (submode CRP), the aircraft crosses the SP-50 landing course line.

20. To use this mode -- when flying in the to-and-from-azimuth mode on a given azimuth of beacon RSBN-2S or in the SRP submode and before entry into the zone of the SP-50 system course beacon (the entry into the zone is indicated by the deflection of the position strip on instrument NKP-4 or by the light signal labeled "Flight Over the Zone" ("Prolet zony")) --

place the ILS-SP-50 selector switch in the SP-50 position, the selectors on the KU in the ARK1 and ARK2 positions, and the marker selector in the landing position; use rack-&-pinion to set the pilot's specified course pointer on the NKP-4 instrument to the landing course value; place the STU selector switch on the VSU-3P control panel in the ready position; and put the KPP-navigator, NKP-pilot selector switch in the NKP-pilot position.

21. Using the PP-LPM instruments of both pilots and the captain's NKP-4 instrument during semiautomatic flight or the BSU-ZP system during automatic control, continue the flight along the specified azimuth of beacon RSBN-2S, and watch on the NKP-4 instrument the moment of entry into the equal signal zone of the SP-50 course beacon.

22. On entry into the equal signal zone of the SP-50 course beacon, swing the airplane, using the gyro-horizon and the copilot's NKP-4 instrument, to the landing course or to the opposite course depending on the distance of the plane from the airport and the flight altitude at the moment of entry into the zone. The swing can be accomplished with manual control or with the autopilot using the control labeled "Swing" (Razvorot").

23. With the automatic pilot on when the copilot swings to the landing course, the pilot must set the specified course pointer on the NKP-4 instrument to the landing course value, switch the PRR selector on the radio systems selector from the RSBN/SP-50 position to position 1, and start piloting the aircraft, together with the copilot, using instruments PP-IPM and NKP-4. After the pilot switches the PRR from

the RSBN-SP-50 position to position 1, the copilot can use the PP-IPM instrument command pointer to complete the swing to the landing course. After
(2-76) entry on the landing course, turn on the course light button and continue the flight in the same manner as with the SP-50 system.

24. With manual control when swinging on a course opposite to the runway, leave the switch on the radio systems selector in the RSBN/SP-50 position until beginning the standard swing to the landing course. Use the gyro-horizon and the copilot's NKP-4 trajectory position pointer for the flight opposite that of landing. The trajectory position pointer will give a reverse reading.

The starting point for making the standard swing is determined from the reading of the specified value for the current azimuth relative to the RSBN-2S system beacon on the IPDA-P instrument.

When the copilot makes the standard swing, the pilot must perform the same operations as in the swing to the landing course.

After the copilot switches the PRR from the RSBN/SP-50 position to position 1, the copilot can use the PP-IPM instrument command pointer to continue the standard swing.

25. After entry on the landing course, connect the course light button and pilot the plane according to the method described in the subsection titled "Landing by the SP-50 System."

A second variant is also possible for the joint use of the RSBN-2S and KURS-MP-2 systems. Before entering the zone of the SP-50 course beacon, switch the BSU-ZP system to the course stabilization mode, tune both halves of the KURS-MP-2 system to the working channel of the SP-50 beacon, place the PRR on the radio systems selector in position 1, set the specified course pointer on both MKP-4 instruments on the landing course, and at the moment of entry into the equal signal zone of the course beacon connect the course light button to bring the aircraft on the landing course with the autopilot.

The NAS-1A6 Aircraft Navigation System

Functional Designation

The purpose of the aircraft navigation system NAS-1A6 is to provide automatic flight along the specified course line while the AP-6YeM-ZP autopilot is on.

Preflight Check and Preparation of the NAS-1A6 System

The technician checks the NAS-1A6 system and readies it for flight, or this is done by the navigator within the following scope:

1. Checks all controls for location in the initial position.

2. Uses proper cables to connect the control panel (unit 7) with the K test socket (Sh10) on the front panel of unit 3. Places the switch on the test panel in the off position and the calibration toggle switch in the calibration position.

(2-77) 3. Turns on the NAS-1A6 system and the KS-8 and AGD-1 units.

4. Checks the 115-volt AC and +27-volt on-board circuit on the test panel. The test panel meter pointer should be within 25 ±2.5 small divisions of the scale.

5. Check the regulated DC voltage on the test panel. The pointer

should be within the red marks.

6. Not earlier than 5 minutes after turning on the high voltage, check the voltage proportional to the magnetron power and the voltage at the output of the second detector of the receiver. To do this, place the switch consecutively in the positions labeled "Magnetron Check" ("Kon-
(2-78) trol' magnetrona") and "Detector Voltage" ("Napryazheniye ND"). The test panel indicator pointer should be within 1-3 numbered divisions of the scale in the magnetron check position. In the ND position, the pointer should read no greater than five small division of the scale.

7. Check the crystal current by placing the channel toggle switch in the signal position. Place the left selector switch on the control panel (unit 6) in the position labeled "TAM." Set, consecutively, the selector on the test panel in the positions labeled "Crystal I current" ("Tok kristalla I") and "Crystal II current" ("Tok kristalla II").

The instrument pointer should be within the range of one to three numbered divisions of the scale. In each of the two positions of the switch turn the high voltage on and off, the readings on the test panel meters should diminish.

Set the channel toggle switch in the AFC (APCh) position. Perform the measurement in the same way as when the toggle is in the signal position. The test panel meter should read within one to three numbered divisions of the scale when the high voltage is switched on. With the high voltage turned on, the test panel meter reading should diminish.

8. Not before 5 minutes after the high voltage has been turned on, take

the ground speed "W" and the drift angle "α" meter readings (of unit 4) in the test I mode. The measured value of W should not differ from the calculated by more than ±2.5 km/hr plus 0.7% of the air speed. The calculated value is equal to 530 km/hr.

The measured value of α should not differ from the calculated by more than ±40'. The calculated value is equal to 0°.

9. Set the given course angle to equal the course value. Switch on the meter toggle; the test index C on the meter (of unit II) should rotate counterclockwise, while index V should not move.

10. Put the system in the Test 2 mode. After 5 minutes again read ground speed W and drift angle α from the meter (of unit 4).

The measured value of W should not differ from the calculated by more than ±2.5 km/hr plus 0.7%; and α by ±40'. Calculated W is equal to 1,007 km/hr; and calculated α, 9° 25'.

11. Turn on the meter toggle. The reference indexes S and V (meter on unit 11) should move counterclockwise. The movement of index V should be considerably slower than of index S.

12. Place the left selector switch on the control panel (of unit 6) in the position labeled "PAM."

The speed and the direction of movement of indexes S and V should not change.

13. Locate the left selector switch of unit 6 in the high position; and the right, in the test-1 position.

With the control labeled "Execute Left Lateral Deflection" ("Vvod LBU") of unit 16 set the left deflection to +2 km (or -2 km).

Switch the system to automatic control by turning the knobs labeled "Automatic Control System On" ("Vkl. SAU") of unit 16 clockwise all the

(2-79) way. The signal lamp on the dial of unit 16 should light; and the ailerons should move into the position producing a left (or right) bank.

With the execute-left-lateral-deflection control of unit 16 set the lateral deflection to 0 km.

Set the given course angle to 30° on the chart angle reference input element (of unit 14).

Turn on the meter toggle.

The ailerons should now move into the position for a right bank, and the indicator pointer of unit 16 should rotate counterclockwise.

Set the given course angle to 330° on the chart angle reference input element (ZUK) of unit 14.

Set the deflection to 0 km with the execute-left-lateral-deflection control of unit 16.

The ailerons should move into the position producing a left bank, and the indicator pointer of unit 16 should move clockwise.

Turn the automatic control system knob all the way counterclockwise.

Turn off the meter toggle, and set the lateral deflection to 0 km using the execute-left-lateral-deflection control of unit 16.

Turn off the autopilot.

14. Place the toggle labeled "NAS-IA6-ANU auto" in the "ANU auto" position. Check the independent operating mode of the ANU as follows:

Turn on the meter switch of unit 11.

Set the given course angle to zero with the ZUK-1 chart angle reference input element of unit 14.

Set the course to 45° on the K scale of the BK-1 switching unit.

Set the wind velocity on the ZV-1 wind reference input element at zero. Set the true air speed at 200 km/hr (monitor on the DVS unit dial of unit 12), and smoothly increase the given true air speed to 800 km/hr. Watch the reference indexes on the meter (of unit 11) while measuring the speed.

In the process of increasing the speed, the change in the rate of rotation of the indexes should be smooth without sudden jumps or pauses.

Set the course to zero on the K scale of unit BK-1 (unit 10).

Set the right selector switch on the control panel (of unit 6) in the Test 1 position; this corresponds to a course speed of 530 km/hr and a drift angle of 0°.

Set the true air speed at 500 km/hr; monitor it on the DVS scale (of unit 12).

Place the SCh meter pointers (unit 11) at zero and hold for 5 minutes.

Set the given course angle equal to 90° with the ZUK-1 chart angle reference input element (of unit 14) using the turn indicator ("UP") scale.

Set to zero both S and V pointers of the meter (of unit 11).

(2-80) Actuate simultaneously the meter and the second counter.

Turn off the counter after 22 minutes 38 seconds. The V pointer should have traveled clockwise to the 200-km mark. The S pointer should be stationary and should remain at zero.

On the K scale of switching unit BK-1 (unit 10) set the course to 45°. Reduce the given true air speed to zero. The change in the rotation of the reference indexes should be smooth.

Set the course (on scale K of unit BK-1) and the given course angle on the ZUK-1 scale (unit 14) to zero.

Set the wind velocity to 200 km/hr on the scale of the AV-1 wind reference input element (unit 13). Change the wind direction on the AV-1 scale (unit 13) in the 0-360° range.

The change in the rotation rate of the indexes should be smooth.

Set the wind velocity equal to zero.

The reference indexes should not turn.

a) Turn off the system as follows:

Place the left selector switch on the control panel (of unit 6) at off.

Place the right selector switch on the control panel (unit 6) in the position labeled "On the Ground" ("Susha").

Locate the NAS-1A6-AKU-auto switch in the NAS-1A6 position.

Put the meter toggle in the off position.

Turn the automatic control system knob on unit 16 all the way counter-clockwise.

Place the meter pointer (unit 11) at zero.

Disconnect the check zero from unit 3, and screw on a cap on the K test connection (Sh-10) of unit 3.

The system is ready for use in flight.

In-Flight Use of the NAS-1A6 System

After take-off at an altitude of at least 200 meters, switch the selector on the control panel (of unit 6) to the position labeled "High" ("Vysokoye"), the lamp marked "4" should light.

In 5 minutes after the high voltage has been turned on, the NAS-1A6 system is ready for operation. The course speed and the drift angle indicators will start giving continuous readings for W and α. The aircraft should now have a W speed of at least 500 km/hr.

After passing the departure point, which is selected beforehand, switch on the counter.

The system has facilities for operating in the wind "memory" mode. This calls for positioning the left switch on the control panel (unit 6) in the memory setting. The light register displaying the word "memory" will light.

(2-81) With an 8-12° bank, with a faulty transmitting or receiving tract of the system, and with a flight over a less-than-one-ball sea, when there is no Doppler data, the system will switch over automatically into the wind memory operating mode, and the memory light register will light. The unit 4 indicator will show course speed and drift angle values existing before inception of the memory mode.

The odometer reading (unit 11) can be used only during a limited period of time when the wind direction and velocity changes insignificantly.

If the wind data changes but there is still no Doppler data, place the NAS-1A6-ANU-auto selector switch in the ANU automatic position, the ANU computer will operate independently with the ZB-1 wind reference input element (unit 13), on which the wind and chart angle parameters will be adjusted.

When over the sea, place the right selector switch on the control panel (unit 6) in the position labeled "Sea" ("More").

When using the AP-6YeM-ZP autopilot, turn the automatic control system knob on unit 16 all the way clockwise to switch the system on for automatic course correction and for making the swings.

To enter a new orthodrome, set the specified course angle (chart angle) of the new orthodrome on the chart angle reference input element, and the lateral deviation from the orthodrome on the lateral deviation indicator (unit 16); the aircraft will then automatically enter the specified orthodrome.

<u>13a. The KS-8 Course System</u>

The KS-8 course system with two GA-1M gyro units (main and reserve channels) is installed on the aircraft.

The following must be taken into account when using the system:

1. During a normal start, make sure that the mode selector on the course system is in the directional gyro (GPK) position, that the aircraft axis coincides with that of the runway, and that the take-off and landing runway course is set out with the course reference input element on the course system control panel.

(2-81a, 465L) 2. In flight, the course system can be used in the magnetic compensation (MK) and directional gyro (GPK) modes.

3. The course system's accelerated coordination button should be used only after switching from the directional gyro-compass to the magnetic compensation mode.

4. If the system's main GA-1M gyro unit breaks down, the system can be switched to work with the reserve unit. The switchover is accomplished with the switch on the system's panel.

Bear in mind that during the changeover the airplane must be in level flight.

5. After landing, do not de-energize the system before the aircraft taxies to park.

6. The time required for the system to be ready for operation in the magnetic compensation mode with the ambient air temperature ranging from -60° to +50° C is 5 minutes; in the directional gyro mode, it is 12 minutes.

14. The BSU-ZP On-Board Landing Approach Control System

1. The on-board control system is intended for continuous automatic control of the aircraft in the navigation mode from a 200-km altitude and in all operating modes while landing.

The BSU system provides:

-- aircraft stabilization around the center of gravity relative to three axes,

-- stabilization of the given barometric flight altitude,

-- performance of coordinated turns, climbs, and descent using the control panel levers,

-- automatic and semiautomatic control of the aircraft with signals from the landing and approach-navigation system RSBN-2S (in the SRP, azimuth, and cloud penetration submodes) and from the system in the azimuth-toward and azimuth-from modes,

(2-82 435L) -- automatic and semiautomatic control of the aircraft during landing approach with signals from the SP-50, the ILS, and Katet-S systems from the moment of initiation of the fourth swing to an altitude of 50 meters, and

-- stabilization of the specified course line with the NAS-1A6 automatic Doppler navigation system.

2. The on-board BSU-ZP system is a consolidated combined aircraft control system which includes the AP-6YeM-ZP autopilot, the Put'-4MPA flight navigation system, and the AT-2 automatic trim-tab unit. Depending on the need, either the entire BSU-ZP system or its individual channels (the autopilot with the automatic trim-tab unit and the Put'-4MPA) may be used.

The system has a single control panel located between the pilot and copilot. It is turned on with circuit breakers, selector switches, and buttons. The aircraft is controlled by means of levers labeled "Swing" ("Razvorot"), and "Descent-Climb" ("Spusk-Pod"yem") or by the autopilot with signals from the Put'-4MPA system when the course and glide-path light buttons, located on the PU16 AP-6YeM-ZP control panel, are switched on.

3. The BSU-ZP system is intended for use on the plane under the following conditions:

-- at altitudes up to 15,000 meters,

-- at true air speeds between 240 and 1,000 km/hr, and

-- in the ambient air temperature interval +50° to -60°C.

4. The instrument precision of the system in leading the aircraft to the landing trajectory provided by the SP-50, ILS, and Katet-S systems (in the region of the short-range guidance radio station) is as follows:

-- course, ±30 m,

-- glide path, ±10 m, and

-- stabilization accuracy on a specified course line with VOR beacons, ±3 km.

5. Stabilization accuracy when using the autopilot is as follows:

-- course, 0.5°,

-- bank, ±1.0°,

-- pitch, ±0.5°, and

-- altitude, ±25 m.

Preflight Check of the BSU-ZP System

Preflight check of the BSU-ZP system is performed by the special equipment technician or by the captain in the following sequence and scope:

1. Make sure that the AP-6YeM-ZP, AT-2, PGV-4, BK-4, Put'-4MPA, and KS-8 circuit breakers are turned on;

2. Check the switching-on of the PT-1000TsS converter.

(2-83) 3. Turn on the Put'-4MPA, press the button labeled "Stop, Central Gyro Vertical" ("Arretir, TsGV") for 20-30 seconds on one of the PP-1PM instruments of the pilot or copilot, and check for proper recovery of both TsGV-4 gyro vertical units' gyro assemblies.

NOTE: In stopping the TsGV-4, two-three brief repeated pressings of the stop-central-gyro-vertical button are permitted.

4. Make sure that the central-gyro-vertical (TsGV) switch and the swing, descend-climb, and bank levers are in the neutral position.

5. Make sure that the switches labeled "Longitudinal" ("Prod.") and "Transvers" ("Poper.") are on, and the ones labeled "Ready Autopilot" ("Podg. AP") and "Remote Control System" ("STU") are off.

6. Open all light-button filter shutters.

7. Give the order to the navigator to turn on the KS-8 course system.

8. Switch on the autopilot-ready switch on the control panel, and check the operation of the automatic centering of the autopilot on the lateral and longitudinal channels by the appearance of the "Ready" ("Podg.") display on the yellow background blinkers. The automatic centering time is 15-20 seconds. When centering, hold the ailerons near their neutral position.

9. Check the operation of the blocking system. In the "Off" display position on the red background of the control panel (this is achieved by tilting the corresponding control), depress briefly the autopilot-on button on the control panel. In this case, the rudder and elevator control should move freely to the stops. This check should be conducted for the rudder and elevator channels.

10. When the autopilot channels are ready to be switched on, press and release the autopilot on button ("Vkl. AP"); this should make the "on" display on the green background appear on the longitudinal and transverse stabilization blinkers.

Applying force to the controls, make sure that the power section of the autopilot is turned on.

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NOTE: At the moment the autopilot is turned on, the aircraft controls (column control yokes, and foot pedals) may be deflected in either direction through an angle not exceeding 0.3°.

11. With the autopilot on, press and release the altitude corrector (Vkl. KV") on light button; the lighting of the lamp signals that the altitude corrector is on.

NOTE: As soon as the descent-climb lever is touched, the altitude corrector is automatically switched off and the light goes off.

12. Check the operation of the handle labeled "Swing" ("Razvorot") by pressing on it, this should disconnect the clutch from the course system (the foot pedals and the control wheel should not move). Then move the handle from neutral to the right and left, the control wheel and the foot pedals should move to the right and left, respectively. Return the handle to neutral and release it.

13. Check the autopilot with the longitudinal and transverse switches off.

With the autopilot and the corrector off, turn off the longitudinal switch;
(2-84) this will switch the autopilot longitudinal channel to the ready mode, which may be checked by the appearance of the ready display on the yellow background on the longitudinal stabilization blinker. At the same time, the elevator steering motors braking solenoids are disconnected (this can be checked by the free movement of the control-yoke column) and the altitude corrector is also turned off (the altitude corrector lamp will go off). Disconnect the transverse switch, the autopilot lateral channel will be switched to the ready mode, which is checked by the appearance of the ready display on a yellow background on the transverse stabiliation blinker. At the same time, the ailerons and rudder steering motors braking sole-

noids should be disconnected (this is checked by the free movement of the control yoke and foot pedals).

14. Check the operation of the descent-climb lever.

Turn the lever to the descent side, the control-yoke column should tilt forward; turn the lever toward the climb side and the column should tilt back. Set the lever in neutral.

15. Check the operation of the bank ("Kren") lever. Turning it to the right or left should cause the control yoke to turn to the right or left, respectively.

NOTE: When proceeding with steps 13-16 of the check, the automatic pilot will switch off when the control system is on.

16. Check the operation of the autopilot quick disconnect buttons. Holding the controls manually, press the button on the captain's control yoke, the rudder and elevators should be at once disconnected from the autopilot control and the off display on the red background should appear on the blinkers of both stabilizations. The altitude corrector should disconnect (this is checked by the extinguishment of the altitude corrector light button). Disengagement of the autopilot with the quick disconnect buttons is accompanied by the sounding of the howler.

To reconnect the autopilot, disconnect and then reconnect the autopilot ready switch and press the autopilot on button on the control panel.

Repeat the above-mentioned check with the quick disconnect button depressed on the copilot's control yoke.

17. Check the monitor unit's operation from the BSU monitor button. Turn on the autopilot. Press and hold the BSU monitor button. In 2-3

seconds, the "Autopilot-Transverse" ("AP-bok") and "Autopilot-Longitudinal" ("AP-prod") light register displays should light on the pilots' instrument panels and the howler should shriek intermittently.

The autopilot must not be engaged now.

Release the BSU monitor button, both light and sound signals should go off.

18. Check the operation of the monitor unit by forcing the steering motors. With the autopilot on, gradually force the control-yoke column toward you and then away from you until the monitor unit functions and the autopilot longitudinal channel disconnects. Disconnection of the channel is checked by the free movement of the control-yoke column. The longitudinal autopilot light register will light on the pilots' instrument panels, the howler will sound intermittently, and the off display on a red background will appear on the control panel longitudinal stabilization

(2-85) blinker. Switch the longitudinal selector off and on, this should cause the light and sound signals to go off.

Make a similar check for the transverse channel. In this case, the autopilot transverse light register should light on the pilots' instrument panels and the howler should shriek intermittently.

Turn the transverse switch on and off, the light and sound signals should cease.

In-Flight Operation of the BSU-3P System

1. Before taxiing from the parking area, the captain should make sure that all circuit breakers of the BSU-3P system are on. To speed up the

the restoration of the vertical gyros, press one of the central-gyro-vertical stop buttons on the PP-1EM instruments.

2. The autopilot may be turned on after attaining an altitude of at least 200 meters in either the climb or level-flight modes.

Turn on the autopilot heater before taxiing for take-off.

The autopilot is turned on with the autopilot ready switch and with the subsequent depression of the autopilot-on button on the control panel; this will connect the longitudinal and transverse autopilot channels. At the same time the longitudinal channel is switched on, the AT-2 trim-tab unit is turned on.

WARNING: 1. The autopilot must not be engaged in the following cases:

-- if the course system is out of order;

-- if at the instant the autopilot is switched on, the aircraft radically changes the flight mode, in this case switch the autopilot off and rebalance the aircraft and switch it on again. If the fault repeats, the autopilot must not be turned on in flight.

2. Mechanical use of the trim-tabs is not permitted when the autopilot is used.

3. With the autopilot on, switch the KS-8 course system from the directional gyro to the magnetic course modes or from one gyro unit to another with the coordination button depressed. Hold the button depressed until coordination is completed.

4. When using the autopilot in flight, one of the pilots must continuously monitor its operation.

3. The autopilot and the trim-tab unit are used when flying the route with stabilization of the orthodromic course and specified barometric altitude. The computers of the flight and navigation system Put'-4MPA do not function and the visual instruments of this system (PP-1EM and NKP-4) are

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used as ordinary flight instrumentation. The command pointers PP-1PM at this stage are separated for a better view of the gyro horizons.

(2-86 435L) 4. When flying on the RSBN-2S and VOR radio beacon systems, refer to the section titled "Radio Equipment" and to subsections titled "Kurs-MP-2 Navigation and Landing System" and "RSBN-2S Landing and Approach-Navigation System."

5. To gain or to lose altitude, the captain must place the descent-climb lever on the control panel in the corresponding descent or climb ("Spusk-Pod"yem") positions.

6. To change the flight course, press the swing ("Razvorot") lever on the control panel in the direction of the swing, the swing will be in coordination with the bank depending on the extent of lever movement. The lever has two detents: the first stop for a bank of 15°; and the second, for 22.5°.

7. For automatic stabilization on a course line established by the VOR and RSBN-2S systems, turn on the STU switch and depress the course light button.

8. For an automatic landing approach after the third swing on a 290° (or 70°) heading or on dispatcher's orders, press the course light button on the control panel. From this moment on the BSU-3P system provides automatic execution of the fourth swing and plane stabilization in relation to the equal signal zone of the course beacons of the SP-50, ILS, or Katet-S systems.

Having determined the moment of entry into the glide-path equal-signal

(87-2 465L) 11. When the TsGV-4 system fails, signaled by the lighting of the central gyro vertical lamp on the light register and by intermittent sound signals, the captain must determine which of the two vertical gyros failed by matching the readings of the three horizon indicators (two from the PP-1PM flight instrumentation operating from the corresponding TsGV-4 vertical gyros and one from the AGD-1 indicator).

To continue the flight after having located the faulty vertical gyro proceed as follows:

-- if the left vertical gyro has failed switch the autopilot to the right vertical gyro by placing the central gyro vertical ("TsGV") switch in the position labeled "Central Gyro Vertical Right" ("TsGV prav."); and

-- if the right vertical gyro has failed place the central gyro vertical switch in the position labeled "Central Gyro Vertical Left" ("TsGV lev.").

After performing these steps, recenter and engage the autopilot if it has been disconnected by the control system.

If the lateral control channel fails, the BSU-ZP system automatically switches over to the course stabilization mode maintained by the system at the moment the channel failed. In the presence of any discrepancies in the longitudinal channel at flights above 150 meters, it automatically switches to barometric altitude stabilization; and below 80-100 meters, to the prolonged glide path.

The AP-6Ye Ver. 41 V.K. Autopilot

Preflight check of the Autopilot

The captain or the copilot must check the working order of the autopilot on the ground, before starting the engines, in the following sequence:

1. Unlock the rudder and elevators and move them from stop to stop two or three times while checking for rubbing in the controls.

2. Make sure that the longitudinal and transverse selector switches are on and the swing, descent-climb, and bank levers on the autopilot control panel are centered.

3. Switch on the AP-6Ye and AP-6Ye-heater circuit breakers. The heater should go on regardless of the ambient air temperature.

NOTE: With the ambient air temperature below -20°, the autopilot heater should be turned on an hour before take-off.

4. Connect the operating PT-1000Ts converter. Energize the AP-6Ye and immediately press the stop button on the captain's PP-1PM instrument, while watching for the restoration of the central gyro vertical on the gyro-horizon indicator. Keep the button depressed for 40-60 seconds. The button may be depressed two or three times.

NOTE: The autopilot gyro units and the course system must be turned on 15-20 minutes before take-off.

Switch the KS-8 course system to the magnetic course (MK) mode and match the main and stand-by gyros, and then place the main--stand-by ("Osn.-Zap.") (2-87a 465L) selector on the PU-1 panel in the main position; and the mode selector, in the directional gyro ("GPK") position. Set the latitude potentiometer to the take-off airport latitude.

6. Turn on the autopilot ready ("Podgotovka AP") switch on the autopilot control panel and check the automatic centering function by the lighting of the autopilot-ready-on ("Gotov. vkl. AP") lamp (automatic centering time is 3-4 seconds). Check also the ready state of the altitude corrector

by the lighting of the altitude-corrector-ready-on ("Gotov. vkl. KV") lamp.

NOTE: When all channels of the autopilot are centered, the green autopilot-ready-on lamp will light. Should the lamp not light, make it light by turning the bank ("Kren") lever.

Check the interlocking for switching on the braking solenoids of the rudder and elevators motors. The interlocking is operating properly when the autopilot-ready-on light is off (it may be extinguished by turning the control yoke away from neutral), when the autopilot will not go on, and when the ailerons, elevators, and rudder will move freely with the on button depressed.

7. Make sure that all autopilot channels are centered by the lighting or blinking of the autopilot-ready-on lamp. Turn on the autopilot with the on button; this should extinguish the ready light, turn on the autopilot-on light, and lock the rudder and elevators.

Apply force to the controls and make sure that the autopilot power unit is on.

8. Check the operation of the swing lever as follows:

a) swing the lever from neutral first to the right and then to the left to zero, the pedals and the control yoke should not move and the autopilot clutch should disengage from the course system;

b) swing the lever to the right to the first stop and then to the second, the control yoke should move to the right, and the right pedal progress forward;

c) swing the lever to the left to the first and then to the second stop, the control yoke and the pedals should move in the reverse direction;

d) place the lever in neutral.

9. Check the operation of the bank ("Kren") lever, when moving it to the right or left, the control yoke should turn to the right or left, respectively.

10. To check the operation of the descent-climb lever proceed as follows:

a) swing the lever to the descent side, the column must tilt forward;

b) swing the lever to the climb side, the column should tilt back;

c) place the lever in neutral.

11. When the altitude-corrector-ready-on ("Gotovn. vkl. KV") lamp lights, press the altitude corrector button to turn the corrector on. If the lamp goes out, this will indicate that the corrector is on. The column should not be tilted now.

(2-87b 465L) NOTE: The moment the descent-climb lever is moved, the altitude corrector is automatically disconnected; this is indicated by the lighting of the altitude-corrector-ready-on lamp.

12. Check the operation of the autopilot quick disconnect buttons as follows:

a) hold the controls manually and press the autopilot quick disconnect button on the left control yoke; the elevators and rudder should immediately be freed from the autopilot control;

b) turn off the autopilot ready switch and after at least 5 seconds turn on the autopilot again;

c) hold the controls manually and press the button on the right control yoke, the elevators and rudder should immediately be freed from the autopilot control.

13. Turn off the autopilot ready switch and make sure that the autopilot is not on during an actual take-off.

In-Flight Use of the Autopilot

The autopilot may be switched on during a straight-line horizontal flight and on a straight climb or descent at 1,000-meter minimum altitude.

Turning on the Autopilot

1. Make sure that:

a) the longitudinal and tranverse stabilization switches are on;

b) the swing, descent-climb, and bank levers are in neutral;

c) the signal lamps covers are open;

2. Trim the aircraft for the established climb (or for any other type of straight line flight) and turn on the autopilot ready switch; in 3-4 second the autopilot-ready-on lamp should light. If the lamp does not light, light it by turning the bank lever on the panel. If the lamp still does not light, the bank channel should be centered by small deflection of the ailerons and simultaneous trimming (center the bank lever) giving the airplane a 1-2° bank. The ball of the bank-and-turn indicator must be in the center.

3. With the autopilot-ready-on lamp lit or blinking on the control pa press the autopilot-on button, the ready light will go out and the aircra will continue the mode of flight in progress at the moment when the autop was switched on.

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4. Apply force to the controls to make sure that the autopilot power is on.

(2-87c 465L)

WARNING: 1. The autopilot must not be engaged if:

a) the autopilot-ready-on lamp is not lit;

b) the course system is out of order; or

c) the flight has not been stabilized (acceleration, deceleration)

2. The altitude corrector must not be turned on:

a) when climbing or descending; or

b) if the altitude-corrector-ready-on lamp is not lit.

5. If as soon as the autopilot is turned on the airplane begins a sharp change in the given flight mode, press the autopilot quick disconnect button on the control yoke to disconnect the pilot. Then turn off the autopilot ready switch, check the levers and the switches on the autopilot control panel for correct positioning, and stabilize the aircraft; then turn on the autopilot again. If the fault repeats, the autopilot must not be switched on again.

6. When the autopilot is on, do not deflect the trim tabs and do not accelerate or decelerate.

7. The autopilot should be disconnected in the same flight mode it was activated (climb, level flight, descent), otherwise the aircraft will be jolted because loads caused by the unbalanced craft will appear on the elevators and the rudder.

8. With the autopilot on, switch the KS-8 course system from the directional gyro to the magnetic course modes or from one gyro to another with the matching button depressed. Hold the button down until matching is

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completed.

9. With the altitude-corrector-ready-on light on during a straight line level flight, press the altitude corrector button; the lamp should go out. The autopilot will automatically maintain the altidude at which the corrector was energized.

NOTE: Each 2-3 hours of autopilot operation in level flight, the aircraft must be stabilized with the autopilot off.

Using the Autopilot Control Levers

The course and altitude of the aircraft can be controlled through the autopilot with the swing and descent-climb levers on the control panel.

1. Moving the swing lever to the left or right will cause the craft to enter a left or right coordinated swing. It will continue as long as the lever is kept deflected. The aircraft's bank angle in the swing is determined by the extent of lever movement from neutral. The maximum bank angle when the lever is moved to the first detent is 15°, and 20-25° when moved to the second detent.

(2-87(4654) NOTE: Turns and course corrections may be made while climbing or descending. To bring the aircraft out of a turn, put the swing lever in neutral.

2. Moving the descent-climb lever toward or away from you will cause the plane's nose to pitch up or down, respectively. If the altitude corrector was on, it will be automatically disconnected the moment the descent-climb lever is touched, and the altitude-corrector-ready-on lamp will light.

To bring the aircraft back into level flight, the descent-climb lever must be brought into neutral. After level flight is stabilized, pressing the altitude corrector button will once again switch in the altitude corrector.

NOTE: If, with the autopilot on, the climb or descent continues for more than 2,000-3,000 meters, the autopilot should be switched off; it should be switched back on only after careful trimming of the elevators and rudder.

3. Moving the swing lever to the right or left at the same time the descent-climb lever is moved backward or forward, will cause the aircraft to make a right-hand ascending (descending) or left-hand ascending (descending) spiral.

NOTE: While making a swing, climb, or descent, the pilot may remove his hand from the corresponding lever. The maneuver will continue until the corresponding lever is returned to neutral.

4. The autopilot is normally disconnected with the autopilot ready switch on the control panel. Before making a landing approach, be sure that the autopilot is off.

In special cases, the autopilot may be turned off by pressing any one of the quick disconnect buttons on the pilots' control yoke and then by disconnecting the autopilot ready switch.

NOTE: The autopilot may also be disconnected with the AP-6Ye power supply circuit breaker and with the autopilot switch. After landing, the elevators and rudder motors heaters should be turned off.

(2-87e 465L) WARNING: When the autopilot is used in flight, one of the pilots must always monitor its operation holding his hands on the control yoke and observing the flight instrumentation readings. If self-oscillations of the rudder, elevators or ailerons occur during an autopilot controlled flight, the crew must immediately disconnect the autopilot.

Using the Autopilot on Straight-Line Sections of the Route

To execute automatic flight on a specified course line, proceed as follows:

-- set the KS-8 course system for operation in the directional gyro mode;

-- set the value of the specified course angle of the section on the chart angle reference input element;

-- set Z = 0 km on the lateral deflection indicator;

-- set Z = 0 km (on the "V" pointer) and S = 0 km (on the "S" pointer) on the coordinate register;

-- enter the departure point (or the contemplated starting point for registering the aircraft ground coordinates) with the estimated flight course (taking the drift angle into account);

-- switch on the aircraft present ground coordinates register;

-- to transfer to automatic flight on a specified course line using the NAS-1A6 and AP-6Ye systems, turn the automatic control actuating ("Vkl. SAU") handle all the way clockwise on the lateral deflection indicator. The green signal lamp should light indicating engagement of the NAS-1A6 system with the AP-6Ye autopilot.

Monitor the present Z, S, W, and drift angle readings while flying on the specified course line as well as the accuracy of the orthodromic course indications generated from the KS-8 and displayed on the navigator's, KPP-M2, and PKP-4 instruments.

The value Z (LVU and pointer V) must be equal to 0 km; pointer S must show the distance traveled by the aircraft after the course air-mileage odometer was engaged. The course speed and drift angle indicator should give current readings.
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Automatic Update at Next Route Section

To fly on a new (next) section of the route, proceed as follows:

-- follow the present route section in the automatic pilot mode;

-- the moment the aircraft enters the calculated value of the linear angle of turn, set the specified course angle of the next route section on the reference input element and then the calculated Z value on the lateral deflection indicator;

-- set the caculated reading -S (for pointer S) and the value V (for pointer V) on the coordinates register.

EXAMPLE: Given the calculated data Z =-10 km and -S = -10 km. When the aircraft is at the turning point, set manually Z = -10 km on the lateral deflection indicator and the V pointer reading to 990 km on the coordinates register.

-- after entering the new course line (next section), the value of Z on the lateral deflection indicator and the reading of the V pointer on the coordinates register should both be equal to zero.

Automatic Conversion to New Flight Path Paralleling the Assigned Route

Automatic departure to a new course path, paralleling the specified section of the route, is possible within a ±25-kilometer lateral deviation range.

Departure to a new course path is as follows:

-- set the required displacement for the new course path on the lateral deflection indicator;

-- the aircraft will start an automatic turn to the new course [illegible]; after the value Z diminishes to zero on the lateral deflection indicator, the plane will come out of the turn and fly the new course path.

After transfer to the new course, the reading of pointer V will be equal to the lateral deviation of the new course from the initial course path.

Correction of On-Route Aircraft [illegible] to the Assigned Course upon Discovery of [illegible]

If the crew has ascertained the ground position of the aircraft ([illegible] through the radar screen or the RSBN beacon, etc.), the current values of

(2-87b 450L) S and Z must be refined.

To do this, manually bring the readings of pointers S and V to correspond with the aircraft's actual ground coordinates.

The aircraft's actual ground coordinates are determined in the Cartesian system of coordinates where the S axis represents the specified course line of the present route section.

If it is necessary to fly a new course path (on discovery of lateral deviation), set the actual value of Z on the lateral deflection indicator and the aircraft will automatically enter the specified route.

The Put'-4MPA Flight-Director System

The Put'-4MPA system is used both independently and with the BSU-8P system.

To use it independently proceed as follows:

-- make sure that the course ("Put'") and the left and right central gyro verticals ("TsGV lev" "TsGV prav") circuit breakers are connected;

-- turn on the course ("Put'") system power supply switch;

-- if the system is connected on the ground, press one of the PP-1PM instrument buttons before take-off, and with the gyro horizon indicator make sure that the central gyro vertical left (on the captain's instrument) and the central gyro vertical right (on the copilot's instrument) are reset.

The Put'-4MPA system will work in conjunction with systems Kurs-MP-2 and RSBN-2S. The operating mode of the Put'-4MPA system corresponds to the operating modes of these systems and is established by the radio systems selector, which has the following five positions: RSBN, RSBN/SM-50, 1, joint

("Sovm."), and 2.

The RSBN position connects the PP-1PM and NKP-4 instruments of both pilots to the RSBN-2S system; the RSBN/SP-50 position connects the PP-1PM instruments of both pilots and the captain's NKP-4 to the RSBN-2A system and the copilot's NKP-4 to the right half of the Kurs-MP-2 system; position 1 connects the PP-1PM and NKP-4 instruments of both pilots to the right half of the Kurs-MP-2 system; the joint position connects the PP-1PM instruments of both pilots and the captain's NKP-4 to the first half of the Kurs-MP-2
(2-88 265L) system, and the copilot's NKP-4 to the second half; and position 2 connects the PP-1PM and NKP-4 instruments of both pilots to the second half of the Kurs-MP-2 system.

Semiautomatic flight with the Put'-4MPA system can be accomplished with the following two methods:

-- using the position strips of instrumets NKP-4; and

-- using the director pointers of the PP-1PM instruments. To use the director pointers, the STU selector switch on the PU-16 control panel of the AP-6YeM-ZP system must be placed in the ready position.

A discrepancy greater than 6 mm ±2 mm (because of faults in the system sets) in the deflected director pointers of the roll and pitch controls is signaled by the lighting of the "Course lateral" ("Put' bokovoy") and "Course longitudinal" ("Put' prodol'n.") lamps on the pilots' light registers.

The light signals indicate that there is a discrepancy in the pointers, but does not show which half of the system gives the wrong command.

The faulty half of the system must be identified through the analysis of the readings of several instruments showing the aircraft's position relative to the specified course line.

After locating the faulty set, the plane must be flown by the pilot whose half of the Put'-4MPA system is in good working order.

When using the RSBN mode, the right half of the Put'-4MPA system can operate with the copilot's NKP-4 system or with the navigator's KPP-M2 instrument. The NKP-KPP selector switch is used to connect these instruments to the right half of the Put'-4 MPA system. The switched-on position of the navigator's KPP-M2 instrument is signaled by the lighting of the KPP-on signal lamp located next to the KPP-M2 instrument.

Semiautomatic flight methods using the Put'-4MPA system are described in the sections titled "RSBN-2S Landing and Approach-Navigation System" and "Kurs-MP2 Navigation and Landing System."

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14a. THE PUT'-4MP FLIGHT NAVIGATION SYSTEM

1. Functional Designation

The Put'-4MP flight navigation system permits landing approach in the director mode (i.e., the pilot flies the aircraft by the command pointers) using the course and glide-path radio beacons of the SP-50 and ILS systems. It also indicates the basic data on the aircraft's position on the route and during landing approach.

2. Components

The Put'-4MP system consists of two identical sets, one of which is for the captain and the other for the copilot.

Each set consists of the following components:

1. V-4S computer
2. PP-1PM series 2 flight instrument
3. NKP-4 series 3 navigation course instrument
4. U-20M amplifier
5. BR-37 block relay
6. SK-29I juntion box

The Put'-4MP system also includes the BK-5 and BK-6 series 1 combination units, which are common to the two halves of the system.

Red signal light registers, which are energized when there is a fault in the Put'-4MP system, are installed on the pilots' instrument panels.

The command-pointers ("komandnyye strelki"), on-off ("vkl.-vykl.") toggle switch is installed on the top electric panel in the pilots cockpit.

The following are the system's data units:

1. Kurs-MP-1 equipment course radio receiver
2. Kurs-MP-1 equipment glide-path radio receiver
3. TsGV-4 vertical gyros:

   the left (AP-6Ye) for the captain, and

   the right for the copilot.
4. KS-8 course system

3. Operating Principle. Landing-Approach Characteristics When Using The Command Pointers

The Put'-4MP system operates in the following manner:

Signals from the aircraft's heading, roll, and pitch data units and the

course zone and glide-path signals from the Kurs-MP-1 equipment are fed to
(2-83b 465L) the system's computer, which generates flight commands, which are displayed to the pilots in the form of deflections of the command pointers on the PP-1PM instruments.

The deflection of the command pointers indicates the need for generating a bank (coordinated turn without slipping) and pitch of a specified magnitude, which will make it possible to smoothly bring the aircraft to the specified course line indicated by the course and glide-path beacons. For the aircraft to go into the required bank or pitch, the command pointers must be placed in the middle of the center ring. If the band or pitch is greater than required, the command pointer will pass through this ring, indicating the need to reduce the bank or pitch.

The system automatically computes drift permitting the aircraft to fly on the specified course line with a selected lead angle. Flying the aircraft with the command pointers located in the same instrument as the gyro horizon frees the pilot from the need to distribute his attention among several instruments in order to analyze them and to compute a solution to fly the aircraft. This is the feature which distinguishes the landing approach with the Put'-4MP system from the approach using the PSP-48 (KPP-M2) instrument.

It must be remembered, however, that the command pointers do not show the aircraft's position relative to the course zone and glide path; but only give the command to make the bank or pitch of the required magnitude.

When using the command pointers to fly the airplane, the pilot must keep the pointers inside the center ring. This calls for moving the controls through small angles.

Even with large deflections of the control pointers, large movements of the controls should not be attempted to avoid "buffeting" the aircraft. As soon as deviations occur, quickly bring the pointer back to the center with the controls. As the pointer moves toward the center, its movement should slow down. When flying the aircraft with the command pointers, systematically monitor the plane's position with the gyro horizon, and periodically with the readings of other instruments (NKP-4 and VAR-30).

When the command pointers are used, the aircraft is stabilized on the course and glide-path equal-signal lines; therefore the accuracy with which the plane will enter the specified course line depends on the precision of laying the course zone or glide path of the radio beacons. This means that, for example, if the course zone is laid incorrectly, the aircraft will then fly to the right or to the left of the runway axis (depending on where the zone is deflected), even though the pointers (or strips) of the course line on the KNP-4 will be in the null position.

In case the glide path's equal-signal line-slope angle is different from the angle set by the given airport, the aircraft will proceed over the outer and inner marker beacons at altitudes differing from those established at the given airport, although the pointers (strips) on the PP-1PM and NKP-4 will be in the null positions.

In some cases, there is interference in the course and glide-path radio beacon signals causing rapid deflection of the pointers (strips) on the PP-1PM
(2-83c 465L) and NKP-4 instruments. Therefore if sudden deflections of the command pointers occur, do not try to follow them. In this case, attribute the

conduct of the zone position PP-1M and KPP-4 pointers to the presence of interference; and after it ceases (when the position strips stop moving) continue to fly with the command pointers.

4. Put'-4MP System Error Warning

Discrepancy signaling in the Put'-4MP system is based on the comparison of the command pointers positions in the left and right halves of the system.

If for any reason the two halves of the system give the pilots different bank or pitch commands (i.e., the command pointers are separated by more than 6 ±2 mm), the pilots' corresponding signal light registers ("Course lateral," and "Course longitudinal") will light.

If, on making the landing approach, one of the light registers light for more than 3 seconds, stop using the command pointers to fly the aircraft and start using the KPP-4 instruments first making sure of their good working order, or else use the ground-control approach.

5. Operation of the Put'-4MP System

The system is turned on after the engines are started and remains turned on during the entire flight.

To energize the system proceed as follows:

1. Switch on the course-power ("Put'-Pitaniye"), central-gyro-vertical monitor ("Kontr. TsGV"), and AP-6Ye toggle switches on the left circuit-breaker panel; and connect the course, central-gyro-vertical, and AP-6Ye toggles on the pilots' top electrical panel.

2. Turn on the Kurs-MP-1 equipment.

3) Press the vertical gyro stop buttons on the PP-1PM instruments and make sure that the gyro horizon readings are correct.

4) Use the control yoke to align the little airplane marks with the gyro horizon lines on both PP-1PM instruments.

5) Establish the take-off course on both NKP-4 instruments.

On-Route Flight

On the route, the PP-1PM instruments are used to fly the aircraft. On the NKP-4 instruments; the moving course scale repeats the navigator's indicator readings; the ARK-NKP-4 pointer is the master radio compass indicator; and the vertical and horizontal strips are the position strips of the SP-50, Svod, ILS, and VOR systems' radio beacon zones.

(2-88a 4651) The right half of the Put'-MP system can operate with the copilot's NKP-4 instrument or the navigator's KPP-M2 instrument. The KPP-NKP switch on the copilot's instrument panel is used to switch these instruments.

Landing approach using the Put'-MP system is described in the section titled "Landing Approach With the SP-50 and Put'-MP systems."

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15. RADAR EQUIPMENT

The radar equipment includes the following:

-- ROZ-1 terrain-scanning radar,

-- SOM-64 aircraft transponder, and

-- UVID-30-15 altimeter.

The ROZ-1 Terrain-Scanning Radar

1. The ROZ-1 radar is intended for terrain scanning, detection of storm fronts, and measurement of the ground speed and drift angle under any climatic conditions.

Preflight Check of ROZ-1 Radar by Navigator

2. The navigator should make the ROZ-1 radar preflight check as follows:

-- turn on the power switch, a green signal light should light on the control panel;

-- use the screen brightness ("Yarkost' ekrana") and marker brightness ("Yarkost' metok") knobs to regulate the sweep line and the brightness of the range markers on the scope;

-- check all the antenna rotation modes with the antenna-inclination ("Naklon antenny"), antenna-rotation ("Vrashcheniye antenny"), and left-right ("vlevo-vpravo") selector switches and the manual-rate ("Skorost' ruchnaya") handle;

-- check for the presence of noise on the scope using the receiver gain knob on the control panel and the noise ("FON") and separation ("vydeleniye") controls on the scope;

-- place the meter test switch in the magnetron current position, and turn on the transmitter; the green signal lamp should come on and the magnetron current reading should be within the limits of the proper sector. (The transmitter should be switched on at least 3-5 minutes after the power has been turned on.);

-- obtain maximum image intesity on the screen by turning the tuning ("nastroyka") knob, and then switch the AP4-PP4 toggle switch to the AP4 position; check for the presence of images on the screen at all ranges;

-- turn on, if necessary, the azimuth marker ("azimutal'naya metk ") selector switch on the scope.

3. The following are monitored while the radar is in operation:

-- the quality and stability of the image on the scope;

-- the stability of the magnetron current meter reading;

-- crystal current stability on the meter with the AP4 connected.

(2-90) <u>In Flight Use of ROZ-1 Radar by the Navigator</u>

4. The ROZ-1 radar makes it possible to perform the following tasks in flight:

-- recognition of landmarks in the absence of ground visibility;

-- identification of storm activity centers and shower areas;

-- determination of the aircraft's ground position by taking bearings of the landmarks seen on the scope;

-- determination of the ground speed and the drift angle of the plane; and

-- guidance to the maneuver and landing-approach starting points.

5. After take-off, turn on the power and the transmitter switches, the green signal lamp should light;

-- establish a barely visible sweep trace with the screen brightness ("yarkost' ekrana") knob;

-- activate the azimuthal rotation of the antenna with the rotation ("vrashcheniye") selector switch;

-- after the red signal lamp lights (indicating the transmitter is on) obtain maximum image intensity of the landmarks on the screen by turning the tuning knobs, and then place the AP4-PP4 selector switch in the AP4 position;

-- select the antenna inclination angle with the antenna inclination ("naklon antenny") knob, and chose the required range with the range ("masshtab") selector switch;

-- give the receiver sufficient gain with the receiver gain ("usileniye priyemnika") knob and manipulate the noise and separation controls for the best terrain image contrast on the scope;

-- establish an acceptable level of range marker brightness with the marker brightness control, and, if necessary, turn on the azimuth marker ("Azimutal'naya metka") selector switch;

-- if it is desirable to monitor a landmark beyond the radar's range scales, activate the required delay. When using the sweep delay, be sure to calculate slant range correctly. The calculation should be made from the first 50-km range marker, whose range with a 30-km delay is equal to 50 km; and with a 160-km delay, 200 km;

-- the navigator selects the antenna inclination angle from the flight altitude and the aircraft's mean pitch angle; in level flight, antenna inclination should be 1-4° downward;

-- on observance of storm activity centers, antenna inclination should be set 0-3° upward. These are observable on the radar scope at distances of 160-200 km, and appear as light spots with trailing ends in the direction of the sweep radius.

The trails are the characteristic recognition signs of the danger areas.

(2-91 435L) 6. The radar is reliable in operation and simple to use. Because it is an independent system, it may be used on flight of any range or duration. The navigator can use it to solve navigation problems during the entire flight. The accuracy of the navigational measurements does not depend on the distance already traveled.

WARNING: In flight, the ROZ-1 pumping valve should be closed*. Should the transmitter high-voltage switch off automatically, which could occur if its seal is broken accidentally, the pumping valve must be opened; and then switch the transmitter off and then back on again using the switch on the radar control panel.

<u>The SOM-64 Radar Transponder and the UVID-30-15 Electrical Altimeter**</u>

The purpose of the SOM-64 aircraft radar is to provide an active operational mode for the air traffic control radars and automatic information transmission concerning the aircraft's number and altitude.

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2. The SOM-64 works with the radar surveillance and aircraft landing

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* The valve is removed with the inlet nipple of the cabin automatic pressure regulator valve, which produces a drop of 0.57.

** Installed on 01-04 aircraft and on series commencing with 02-02.

-- FOREIGN DISSEM

stations equipped with "Number-T" equipment (equipment capable of receiving and returning information from the SOM-64 transponder) or their modifications; it also operates in conjunction with the active (secondary) SSR radars. The SOM-64 radar components include the UVID-30-15 barometric altimeter with which it is electrically coupled.

3. The purpose of the UVID-30-15 is to give the pilot visual readings of the barometric flight altitude and to feed information to the SOM-64 coder with which it is electrically connected.

4. Special calibrated plates installed on the aircraft act as static pressure sensors. The error of transmitting the altitude values from the UBID potentiometric data unit to the SOM-64 indicator does not exceed 40 meters.

Preflight Check of the SOM-64 and the UVID-30-15

Turn on the SOM-64 and UVID circuit breakers on the navigator's electrical panel.

Switch on the UVID selector switch on the pilots' top electrical panel.

Place the SOM-64 power supply switch on the SOM-64 control panel in the top position; this will cause:

(2-92) a) the test lamp on the SOM-64 control panel to light and then go out; and

b) the UVID altimeter indicator scale to operate and to come to rest at a specific altitude.

Use the R_0 knob to set, on the UVID altimeter indicator, the pressure value corresponding to the take-off airport; the indicator should then show a zero altitude reading within a ±10-meter tolerance.

Should the reading be out of tolerance, regulate the R_0 channel with the pressure input knob.

WARNING: The light signal on the UVID front panel should not light. A lit signal indicates the absence of the 115-volt, 400-cycle, AC supply at the altimeter.

Place the operating mode selector on the SOM-64 control panel in the UVD or PBS positions, depending on the territorial state dependency of the base point.

WARNING: If the flight is on USSR territory, place the selector in the UVD position. In all other cases, position it at PBS.

Place the frequency ("volna") knob in the position indicated by the schedule in effect at the base point; and set the KOA on the coder control panel.

Set the number selector switch to the aircraft's number and the channel selector to the channel in effect at the given time, and place the M4 switch in the bottom position.

Use the automatic tester to check the SOM-64 by pressing and releasing the test light button on the control panel. The lamp should light and after some time go out, this indicates that the SOM-64 is in good working order.

In-Flight Use of SOM-64 and UVID-30-15

1. Before take-off, the SOM-64 and the UVID-30-15 must be fully turned on, and the operational controls on the control panel must be positioned in accordance with the instructions given in the subsection titled "Preflight

Check of the SOM-64 and the UVID-30-15."

2. On entry into the secondary ground radar area, the operation of the SOM-64 is monitored by the lighting or blinking of the test light button on the control panel.

3. If it is necessary to make sure of the normal operation of the SOM-64 during the flight, make the check in accordance with the procedure described in the section titled "Preflight Check."

(2-93) 4. When flying over the USSR border, change the SOM-64 operating mode with the UVD-RBS selector switch on the control panel.

5. When landing with the aid of the ground control approach system, establish the G.A.C. mode on the control panel.

When operating with the secondary UVD or RBS radar systems, use the altimeter to fly the plane.

16. THE AUTOMATIC AUASP-3K ANGLE-OF-ATTACK AND OVERLOAD INDICATOR (Slip-Angle Channel Not Used)

1. The purpose of the automatic angle-of-attack and overload unit is in-flight determination, at any given moment, of the vertical overload (n_y) and the present angle (α) and the critical angle (αcr) of attack; it also warns the pilots of the approach to the critical angle-of-attack and overload mode.

2. The UAP-3K indicator, installed on the captain's instrument panel, is used to monitor the present and critical angles of attack. The left section of the scale on the indicator is used for reading the present angle of attack from the pointer (α) and the critical angle of attack from the sector (αcr).

zone from the position of the glide-path strip on the NKP-4 instrument, press the glide-path light button on the control panel; automatic flight on the glide path up to an altitude of 50 meters is assured from this moment.

At 50 meters, use the quick disconnect button to disconnect the autopilot and switch over to manual aircraft control. The longitudinal and transverse channels may also be disconnected separately. The control panel longitudinal and transverse switches for overcoming the autopilot rudder motors through the BK-4 control unit will disconnect separately the longitudinal and transverse channels.

When disconnecting the autopilot channels by overcoming the motors, light and sound signaling will be actuated; they must be turned off with the longitudinal (transverse) switch.

9. When in a prolonged glide path, the system permits automatic descent to an altitude of 30 meters; however, the longitudinal channel of the Put'-4MPA system BS-3 communications unit must be disconnected at 80-100-meter altitude by briefly pressing the descent-climb lever. The glide-path light button will go out, but the autopilot will continue to stabilize the aircraft for average pitch, which was maintained during the glide-path flight.

10. During an automatic landing approach, in case the displays "Path lateral" ("Put' bokovoy") and "Path longitudinal" ("Put' prodol'nyy") light, the autopilot must be switched off and the control switched to the use of the NKP-4 position strips, or another circle (to determine which half of the system failed) must be flown.

When the aircraft reaches the critical angle of attack, the lamp with the stencil "αcr" will light; and when it attains the maximum permissible overload, the lamp with the stencil "$h_{y\ per.max}$" ("h_{ydm}") on the light register on the copilot's instrument panel will light. At the same time the above-mentioned lamps light, the UAP-3K indicator signal lamp and the lamp in the "Attention" light register will light and will remain lit.

Preflight Check of the AUASP-3K

3. Check the working order of all instruments of the AUASP-3K and the reliability of their fastenings, then proceed as follows:

-- switch on the AUASP circuit breaker on the left circuit breaker panel;

-- give the command to lock the limit switch blocking the compression of the forward landing gear strut;

-- press the AUASP test button on the captain's electrical panel; this should light the signal lamps on the UAP-3K indicator and the αcr, $h_{y\ per.max}$ and attention light registers.

Lighting of the signal lamps indicates that the system is in good working order.

(2-94 465L) In-Flight Use of the AUASP

4. The automatic unit is activated at the same time all the circuit breakers are switched on and remained operative in all the flight modes until landing.

5. The unit's heater is turned on simultaneously with the PPD-1V

heater using the VG-15K switches on the pilots' top electrical panels 1-2 minutes before take-off and 3-5 minutes before take-off with icing conditions. The heater should be turned off 1-2 minutes after landing.

6. Because of interlocking in the supply circuit, the AUASP-3K will start operating only after the forward landing gear strut leaves the runway. It is then automatically switched to the take-off and landing mode and the UAP-3K indicator sector will rest on the 8° number, i.e., the value of the take-off angle permissible for the specific aircraft.

7. After the flaps close, the AUASP-3K automatically switches to the flight mode. The α_{cr} sector will begin to move in relation to the M number. When the flaps are being extended, the unit is again switched to the take-off and landing mode.

8. In flight, the pilots must watch that the α (present angle of attack) pointer of the UAP-3K indicator does not move into the α_{cr} sector, and that the h_y pointer does not travel into the $h_{y\ per.max}$ sector.

2-95 Chapter Two. FLYING THE AIRCRAFT

A. NORMAL FLIGHT CONDITIONS

1. Towing Aircraft to Terminal and to Starting Position

1. The aircraft must be towed from its parked position to the terminal and from the terminal to its pre-takeoff location by a tractor with a rigid tow-bar. The pole must be attached by a shear bolt.

The aircraft should be towed over a dry concrete strip at a speed not in excess of 15 kilometers per hour, and not in excess of 5 kilometers per hour near obstacles. When the undercarriage torque links are not disconnected, the angle of turn should never exceed 30 degrees. The turning radius should never be less than 16 meters.

Before towing:

— Make sure that the towing pole is securely fastened to the aircraft and to the tractor;

— make sure that all tarps and covers have been removed from the aircraft, and that all ground equipment has been disconnected;

— make sure that the steering switch for the nose wheels is in the "OFF" position;

— use the hand pump to bring the pressure in the hydraulic brake system up to at least 150 kg/cm^2.

2. When the plane is being towed, the pilot or co-pilot must sit at the controls with his feet on the pedals, ready to apply the brakes if the necessity arises. Under normal towing conditions, the brakes of the aircraft must not be applied.

WARNING: The aircraft may be towed only if the captain or co-pilot is in the crew cabin.

3. Once the aircraft has been towed to the terminal, the co-pilot must receive on board the cargo, mail, baggage and baggage list, and the cargo papers. The co-pilot checks on the cargo loading, the distribution and securing of the load in the aircraft and the seating of the passengers in the aircraft. The actual center of gravity and take-off weight of the aircraft are checked.

4. Before seating the passengers, the co-pilot cools the compartment (summer) or heats the compartment (winter) with the ground air-conditioning system. If the air temperature in the compartment in the summer is above plus 25 deg C (77 deg F), the compartment is cooled down to no lower than 20 deg C (68 deg F), but in all cases so that the difference between the temperature of the outside air and the air in the compartment will not be more than 10-15 deg C. The cooling of the compartment is completed before the aircraft takes off.

Before cooling the compartment, make sure that all the air supply valves to the compartment are open. Open the air vents and the door in the crew compartment.

2-96 To cool the compartment:

Connect the ground air-conditioning hose to the feed pipe.

Open the air supply valves in the passenger and crew compartments.

Open the air vents in the cockpit and the doors into the rear baggage compartment.

Open the cold air supply on the ground air-conditioner.

In winter when the air temperature in the compartment drops to below plus 5 deg C (41 deg F), heat the compartment air up to plus 15-20 deg C (59-68 deg F).

The above temperature should be maintained in the compartments from the time the passengers are seated until the engines are started.

Before turning on the heat, open the slides on the sides of the heating outlets in the forward passenger compartment and the door into the crew compartment and the air vent. The entry doors should be closed. The compartments must also be heated or cooled if the aircraft is parked for more than 1½ hours.

5. After the compartments have been cooled or heated, disconnect the hose of the ground air-conditioning system, and close the hatches, vents and doors.

<u>REMARK</u>:

1. For maximum effectiveness in heating or cooling the crew compartment, turn on the main ventilating fan in the navigator's compartment.
2. During the heating of the compartments, air with a temperature of over 60 deg C (140 deg F) is not fed to the ventilation outlets. The temperature control of the supply air is regulated according to specifications, TU-9, by setting the switch in the "ventilation" position.
3. During hot summer weather when the aircraft is being prepared for flight and is being towed, the entry doors should be opened until the engines are started.

6. Fifteen minutes before take-off, the captain obtains from the cargo dispatcher the center-of-gravity record, then takes his seat, checks the correct positioning of his seat and, depending on the circumstances, requests permission of the flight supervisor to start his engines at his parking spot at the terminal, or to be towed out to a take-off position.

7. At the pretake-off position, the aircraft is brought to a full stop, and the parking brake is applied. The parking brakes may be used

during take-off and in testing the engines.

2-97 465L 2. TAXIING THE AIRCRAFT

Taxiing the aircraft on its own engine power from its parking place to the terminal or to a pretake-off position is done only in exceptional cases; as a rule the aircraft is brought to the terminal and to its pretake-off position by means of a towing vehicle. Only the captain or co-pilot has the authority to taxi the aircraft.

1. Before taxiing the aircraft:

Switch on the rudder-control booster.

Throw the rudder flight-loader* switch to the "ON" position.

Make sure that the emergency brake system is fully charged (210 kg/cm^2).

Throw the spoiler switch to the "ON" position.

Ask permission of air-control-tower to taxi.

2. Once permission to taxi has been granted, press on both brake pedals at the same time, release the parking brake and begin moving straight ahead, increasing the speed of both engines simultaneously.

3. After getting into motion, switch on the nose strut control and depress the strut steering switch to plus-minus 35 degrees.

WARNING: When the aircraft is parked, the nose strut must not be turned by means of the control mechanism. When taxiing, do not make sharp turns with the nose strut rotated to the limiting angle determined by the stops (plus-minus 35 degrees).

4. As the aircraft moves, test the main brakes and then the emergency brakes, by drawing back the control sticks smoothly, first separately

[*rudder flight-loader = spring-loaded rudder deflection-limiting control counterforce] and then simultaneously, with subsequent bleeding of the emergency hydraulic accumulator.

Warning: The emergency brakes are not connected to the automatic brake control; for this reason, strong braking may cause the cover to rupture.

5. If, during a test, the main brakes do not bring the aircraft to a full stop, slowly brake the aircraft motion by means of the emergency brakes and shut off the engines. Do not release the emergency brake levers suddenly because this causes the supply of fluid in the emergency hydraulic accumulator to be used up rapidly. Release the aircraft brakes at the parking site.

6. Do not allow the aircraft to be turned during taxiing if there are people within 50 meters on the side opposite the turn.

Warning: Quick braking of the aircraft motion during turns is forbidden in order to avoid damage to the nose strut control mechanism. If the automatic brake control fails (signal lamps labeled "Автомат тормозов" burn steadily without blinking) shut it off slowly. Take-off is not permitted when this control is not functioning properly.

2-98/465L 7. When taxiing the aircraft in an area where there are liable to be obstacles, obtain the best viewing conditions by opening the two cabin windows and watch the tips of the wings in order to keep them from colliding with any objects in the area. Maintain the direction of motion of the aircraft by a smooth manipulation of the pedals (turning the front wheels), and smooth application of the wheel brakes when necessary. The navigator reports all objects ahead of the aircraft. The co-pilot keeps check on engine-operation and fuel-pump-operation signal lamps.

8. Operating the engines in modes with the air-by-pass valves from the compressor at OPEN-CLOSED (77 - 81.5%) is not recommended.

Warning: The aircraft must not be taxied:

- if the main or brake hydraulic system is not operating properly;
- if either of the tires is damaged;
- if the landing gear signal light is faulty;
- if there is a leak of fuel, oil, or hydraulic fluid;
- if the flaps are extended (except in the cases of taxiing on a taxi track from the approach to the authorized take-off location with the flaps in the take-off position).

9. In taxiing, as in towing, the minimum turning radius of the aircraft must not be shorter than 16 meters, figured from the main strut bogie on the side of the turn. Thus the minimum radius of the rolling path of the nose-strut wheels would, correspondingly, be equal to 25 meters.

Turning on the spot with one landing-gear bogie immobile is forbidden.

10. The taxiing speed is selected by the pilot according to the width of the taxiing track, the condition of the ground surface at the terminal and the presence of obstacles.

11. Turning the aircraft full 180 degrees around requires a taxiing track width of at least 60 meters. If it is necessary to turn 180 degrees on a track less than 60 meters wide, a slight braking of the inside bogie is permitted, as long as it does not cause the inside bogie to turn without moving off the spot.

12. Taxiing off the paved surface onto the ground is permitted only with the concurrence of the dispatcher service.

13. Before the aircraft can be brought to a stop, the front wheels must be in line with the longitudinal axis of the aircraft.

2-99/465L 3. PREPARATION FOR FLIGHT

1. Before take-off, the captain is obliged to know the take-off characteristics of the aircraft, in case one of the engines fails. A sample computation of the take-off characteristics is given in Section 3, page 41. [not available for translation].

2. For definite take-off conditions and take-off weight, the flap angle is selected on the basis of guaranteed safety specification in the event of the failure of one engine:

- during take-off from a concrete runway with a full load, poor runway approach and high ambient air temperature, the flaps should be extended 10 degrees;

- in the case of poorly situated runway, less than full load, good runway approach and moderate ambient air temperature, the flaps should be extended 20 degrees.

When taking off with 10 degrees flap, switch off the automatic howler protection.

<u>During Preliminary Run-Up</u>

- request flight conditions;
- check pressure on the VD-20 altimiter against pressure at airfield level;

- check the position of the indicator on the dial marked "Начала герметизации" ("begin pressurization") on the cabin-air-pressure regulator against the pressure at airfield level;

- check out all the engine operation indicators;

- make sure that the switches marked "Топливомеры", "Автомат", left and right, and "Питание двигателей" (fuel gauges, automatic, left and right and engine supply) are in the "ON" positions, and the switch marked "Перекачка" (pumping) is in the position marked "Автомат" (automatic) ;

- check the autopilot heating switch;

- make sure that the aileron and rudder trim-tabs are in the zero position;

- set the elevator trimmer in the take-off position. Move the pointer on the elevator trimmer star knob one or two degrees toward you;

- set the switch of the independent hydraulic system on the position marked "Automatic";

- switch on the DR-134M yaw damper;

- make sure that the switch of the elevator trimmer electrical mechanism is released and that the elevator trimmer electrical mechanism switch on the upper panel is switched on;

- make sure that the wing de-icing system switch and the cabin pressurization switch are off;

- extend the flaps to the take-off position.

3. Request permission to taxi out to the authorized take-off position. Taxiing out to the runway is done with wheel-turning switch depressed to plus-minus 35°.

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Upon Authorized Take-Off

4. Having taxied out onto the runway, stop the aircraft in the direction of take-off, no more than 100 meters from the beginning of the runway. When the aircraft has reached a full stop, apply the parking brake and release the wheel-turning switch. Switch on the PPD heating (Pitot tube) and the rudder flight-loader. Check for normal instrument readings and correct setting of the rudder trim-tabs. Set the hinged idle stop in the vertical position.

The navigator aligns the course-indicator system KS-8, checks the readings of the course-indicating instruments with the direction of the runway, and switches over to the directional gyro mode.

The co-pilot, upon the order of the captain, reads off the check list of obligatory checks, after which the crew members report to the captain on the readiness of the aircraft for take-off.

4. THE TAKE-OFF

Taking Off Under Normal Conditions

1. Take-off is carried out with the engines operating in the take-off mode. The flap-angle setting at take-off provides for a factor of safety in the event that one engine fails on the take-off run, as well as for the sufficiency of the available runway length.

2. After permission to take-off has been received and instructions have been received for procedure of approach to heading, the captain reports to the crew the moment of take-off by the statement, "We are taking off", then:

2-101/465 L - set the control stick on ½ ahead beyond the neutral position and, while braking the aircraft, move the engine throttle levers smoothly and synchronously all the way forward, after which the co-pilot is given the order, "Maintain throttle !" After receiving the co-pilot's report "I am holding throttle," shift your left hand to the control stick;

- being certain of normal operation of the engines according to the instrument indications, simultaneously and smoothly release the brakes of the main bogies with both feet so that the aircraft will move straight ahead.

NOTE: If, as you move the engine throttle levers all the way forward, you hear the howler signal, abort take-off. Check to see if the flaps have extended to the take-off angle.

3. During the takeoff roll, until the time the time the wheels of the front bogie lift off, slight tendencies of the aircraft to turn are countered by control of the front wheels with the use of the pedals (rudder becomes effective at a speed of 150 kilometers per hour).

4. Upon attaining rotation speed (See Figures: 3-6, 3-7.), draw the control stick smoothly back toward you to separate the front bogie from the runway surface and rotate the aircraft to the lift-off angle of attack.

After giving his report, "I am holding throttle.", the co-pilot holds, without applying force, the throttle levers in the far forward position. As the aircraft moves along the take-off run, he checks the rpm of both engines, speed, pressure and temperature of the fuel and oil, temperature of the turbine exhaust gas and, after lift-off, he checks the altitude, speed, aircraft orientation with respect to the horizon, heading and rate of climb and reports immediately to the captain any deviations of instrument readings from normal.

The navigator reports to the captain over the intercom the indications of speed according to the speed indicator, beginning with 150 kilometers per hour and for each 20-km/hr increment until the aircraft goes over into the climb mode. At the moment motion begins, he switches on the aircraft clock.

5. The lift-off of the aircraft from the ground at the correctly established pitch angle (not over 8-9°) will occur when the aircraft attains lift-off speed.

2-102 465 L 6. After lift-off, increase the speed of the aircraft and climb gradually. When an altitude of 5-10 meters has been attained, brake the wheels and give the order, "Retract landing gear !" After the signal lights indicating retracted landing gear light up, throw the landing gear switch into the neutral position. Climbout is done at a speed of 300 kilometers per hour. At an altitude of 400 meters, shift the stabilizer to the "0" position, increase speed to 330 kilometers per hour, retract the flaps and set the engines over into normal mode.

7. Any pull that is generated on the control stick during the retraction of the landing gear is countered by drawing the elevator trim tab toward you.

8. During take-off under conditions of limited visibility or low cloud cover, the captain pilots the aircraft on instruments immediately following the lift-off from the runway. The co-pilot actively aids the captain in controlling the aircraft and keeping it in the climb mode.

Taking Off In a Cross Wind

The maximum admissible cross wind (90 degree angle from the axis of the runway) during take-off from a concrete runway is 14 meters per second, and 6 meters per second for take-off from an ice-covered runway.

When there is a cross wind, the aircraft tends to turn into the wind during the take-off roll. Holding direction over the initial portion of the take-off roll in three-point orientation until the time when the nose bogie lifts off is done by means of the pedals, that is by controlling the front bogie wheels (rudder becomes effective at aircraft speed of 150 kilometers per hour). If necessary, the wheel brakes may be applied.

At the moment of lift-off the aircraft heels to leeward (in the direction of the pedal deflection); this is countered by a well-timed and forceful deflection of the ailerons by an amount depending on the velocity of the wind.

After lift-off and during the climbout, direction is maintained by variation of the aircraft heading.

Taking Off In a Tailwind

Taking off in a tailwind not over 5 meters per second is permitted. Taking off in a tailwind up to 5 meters per second is done just as in the case of a headwind. However, it must be remembered that during takeoff in a tail-crosswind and in a tailwind, the length of the takeoff roll and the take-off distance is increased on the average by 20-25 meters for ever meter-per-second of the tail component of the wind velocity.

The technique of taking off in a tailwind and a tail-crosswind is the same as in taking off in a headwind.

2-103 / 465 L 5. GAINING ALTITUDE

1. Climbout is done with engines operating on normal mode (92.5 to 94.0 %) at the most advantageous rate of climb (See the graphs in Figures 3.19 - 3.26).

2. After the engines have been put on normal operation, switch on the cabin pressurization and, if necessary, the de-icing system for the wing and tailfin.

3. The co-pilot checks the drop in pressure, the altitude and the temperature of the air in the cabin, as well as the temperature and volume of air supplied for cabin pressurization. Any deviations from the normal instrument readings are reported immediately to the captain.

4. When an altitude of 4,000 meters has been reached, the captain (or the co-pilot, on the captain's orders) puts on his oxygen mask and for the duration of the rest of the flight - until descending to below 4,000

meters - he or the co-pilot wears the oxygen mask while piloting the aircraft.

5. While the aircraft is climbing, the navigator reports the aircraft heading to the captain and monitors the climb mode; after the predetermined flight altitude has been reached, he reports the turning point and heading.

6. When the aircraft has reached flight altitude, set the engines on cruising speed, go into the horizontal flight mode and check the fuel consumption. Set the hinged idle stop into the horizontal position.

6. LEVEL FLIGHT

For a given air speed, the horizontal flight mode is set by instrument (the wide arrow). Depending on the temperature of the outside air, the engine rpm may not correspond to the standard ratings. For this reason, the rpm of the engines must be chosen in each particular flight so as to guarantee the required air speed.

For maximum flight range, the cruising altitude of the TU-134 with D-30 engines in level flight is 11,000 meters.

The cruising speed of the aircraft is 780-870 kilometers per hour.

In quiet air, with a fuel reserve for one hour plus a possible reserve for landing, the flight range of the aircraft with a take-off weight of 44.0 tons and maximum commercial cargo of 7.7 tons is 1,850 and 2,040 kilometers for cruising speeds of 850 and 770 kilometers per hour, respectively.

With a 4-ton commercial cargo (maximum fuel load) the range under the same conditions is 3,250 and 3,570 kilometers.

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Crew Duties During Level Flight

Duties of the Aircraft Commander

- to pilot the aircraft and maintain flight time according to schedule by establishing the operating mode of the engines which will guarantee the computed flight speed;

- to be informed of the weather conditions on all flight routes and to inform the members of the crew of these weather conditions;

- to arrive at a decision in the event of any complications.

Duties of the Navigator

- handles the communications in connection with the flight plan and makes weather observations;

- informs the captain of the aircraft's position and tells him which radio stations are equipped with radio aids. He reports to the captain the aircraft's heading, the ground speed and the times when the aircraft passes check points along the route;

- navigates the aircraft by all available aids to navigation;

- checks the operation of the generators, batteries and transformers, which should be switched on at all times during flight.

If he finds any source of electric power operating abnormally, he immediately shuts it off.

Duties of the Co-Pilot

- pilots the aircraft when instructed to do so by the captain;

- looks out over surroundings, providing lookout over half the sky on the starboard side;

- carries out visual and radio navigation;

- follows changes of pressure, altitude and temperature of the air in the compartments, as well as the temperature and consumption of the air supplied for compartment pressurization;

2-105 / 465 L - checks the operation of the automatic fuel flow system by the fuel gauge and flowmeter during the course of the entire flight by setting the fuel-gauge switch to the position for amount consumed, as the fuel is used up;

- monitors the operational reliability of the de-icing mechanisms according to the signal lamps and the TTsT-13 thermometer;

- checks, by the pressure gauge and the pressure-drop signalling lamp, the operation of the hydraulic system. Frequent automatic switching on of the hydraulic brake pump assembly indicates a leak and loss of fluid from the system;

- monitors engine operation according to instruments:

a) in a fixed flight mode, the operation of the two engines should be exactly the same;

b) if the signal lamp, "Vibrations Large," lights up (rate of vibrations in excess of 50 mm/sec), carefully monitor the change in the rate of vibrations and the operating parameters of the engines (rpm, temperature of turbine inlet gas, oil pressure and temperature).

If the vibration rate continues to climb above 50 mm/sec and the parameters of the engines do not change, then, on the basis of flight conditions, set the engine on the lowest possible operating speed and take all possible measures to establish conditions under which the engine can be cut off. If the rate of vibrations rises to 90 mm/sec, even if the operating parameters change, shut off the engine.

c) If the filter signal lamp illuminates, indicating the presence of metal chips in the oil, make sure that instrument readings on vibration rate, oil pressure and temperature, rpm and turbine exhaust-gas temptures fall within normal operating range for the engine and are in accordance with engine parameters specified by instructions for operation of the engine , and if they are, continue the flight.

Furthermore, during the entire flight, carefully check the operating parameters of the engine and if one of these parameters does not comply with operating instructions, shut off the engine. After landing, check the filter signal and the MFS-30 filter, and clear the matter of further use of the engine with the factory representative.

d) When an engine control is set at the "idle" position, the idling rpm will be higher, the greater the altitude. For every 1,000 meters of increase in flight altitude,the rpm for the idle mode will increase from 1.5 to 3.5 percent (200 to 400 rpm) above the idle speed on the ground.

e) For any rate of pick-up from any mode, starting with the idle mode, the sudden temperature rise of the turbine exhaust gas must not go beyond 630 deg C.

Duties of the Steward(ess)

- keeps passengers out of the forward passageway and the crew compartment, and makes sure that no more than three people congregate in the rear passageway;

- with approach of darkness, switches on the service lights and the circuit breakers of the individual lighting in the passenger compartment. When using the electrical devices in the kitchen and pantry, the steward must obey the following rules:

  - do not plug an electric cord into a circuit if the prongs on the plug or jack are damaged;

  - before plugging in a warming cabinet, make sure there are no extraneous objects in it;

  - do not put down any plugged-in electrical heating device without looking, and do not allow hot plates, ovens or similar devices to overheat;

  - when the aircraft descends for a landing, shut off all electrical heating devices.

7. NIGHT FLYING

Preparation for Flight

1. Preparation for night flight involves carrying out the procedure given in the section, "Preflight Inspection and Check By the Crew," plus the following additional measures:

- check the instrument-panel and switch-panel lighting by switching on the red-white lighting and regulating the brightness by means of the rheostats;

- switch on and check out the navigation lights;
- switch on and check out the OSS-61 flashing beacons;
- check the headlights by extending them and checking the bright and dim beams;
- by turning the caps of the light filters all the way to the right, dim out all the small signal lamps;
- check the lights in the passenger compartment.

2. After receiving permission to taxi, extend the headlights and switch on the taxiing light. If necessary for visibility in the taxiing path, the landing lights may be switched on briefly. The landing light must not burn continuously for more than five minutes.

3. During the preliminary run-up, make sure that the navigating instruments are sufficiently illuminated.

The headlights are switched on during take-off.

WARNING: Each time the headlights have been used, throw their switches into the neutral position.

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465 L Take-off procedure at night is analogous to that for daylight. Degree of rotation is determined by the relative position of the runway boundary lights.

After lift-off, pilot the aircraft by orientation with respect to the runway boundary lights, the gyro-horizon, speed indicator and variometer. After the runway boundary lights have been passed, switch over to instrument flying. After passing all obstacles, retract the headlights.

4. Flight conditions in preparation for coming down to land and maintaining speed are the same as for daylight flying. If the aircraft is to be brought down for a landing with the crew compartment instruments illuminated with red light, the switch from white to red lighting must be done at least 20 minutes before landing.

When coming down to land at night, switch on the landing lights at an altitude of 100-150 meters. Landing with headlights, without landing floodlights, is quite difficult and requires special training and very close attention.

8. FLYING AT MAXIMUM SPEEDS

In normal use at flight altitudes of up to 8,600 meters, the indicated airspeed should not exceed 600 km/hr. At altitudes of over 8,600 meters, the aircraft airspeed is limited to Mach 0.82. The forces exerted on the control stick by the elevator during acceleration are very slight and may readily be reduced by means of the elevator trim-tab. Turns may be executed even at indicated speeds of 600 km/hr, or Mach 0.82, without difficulty. Feedback roll response to rudder deflection occurs at Mach 0.845 and over. Loads on the controls remain straight, but abrupt motions of the controls must be avoided, as must the creation of overloads.

9. FLYING AT MINIMUM SPEEDS

On all stages of flight, excluding take-off and landing, the following minimum controls must be observed for all altitudes and all flight weights:

Minimum indicated Airspeed, km/hr	330	300	270
Flap Angle	0°	10^0	$20^\circ - 38^\circ$

Executing maneuvers at speeds close to minimum requires extremely close attention on the part of the pilot; a maneuver (turn, pull out of descent into level flight, etc) must be executed with minimum overloading and with a roll executed smoothly and not over 20 degrees.

10. FOUL-WEATHER FLYING

When flying under complex meteorological conditions, systematically check the indications of the navigation instruments against the back-up instruments in order to detect any possible instrument failures in good time.

2-108/465 L If a group of the pilot's instruments fail (VD-20 altimeter , KUS-1200 airspeed indicator, VAR-30-z variometer, Mach indicator MS-1) as a result of icing or obstructions in the static line, by means of the valve on the left side of the aircraft switch the pilot's instruments over to the emergency static system. The valve handle should be rotated clockwise, after first disconnecting the locking-piece from the "normal" setting and moving it to the "emergency" setting. If the aircraft has been flying at an altitude of 10,000 meters, the indications of the VD-20 altimeter will

6. During flight in the stratus clouds of a warm front, the occurrence of heavy interference to radio communications indicates the development in this cloud formation of thunderstorm activity, which may not be detected at great distances even by ground radars. Under such conditions, request permission to fly along the upper edge of the cloud formation or to fly by PVP (visual flight rules).

7. In a stormcloud situation characterized by the development of heavy cumulus cloud formations, going through such a formation is categorically forbidden for both take-off and descent for landing. Descent for landing should be arranged by approval of the dispatcher in an area where no such condition is present.

8. Evasion and crossing of frontal storms during flights in cloud formations are permitted, if a reliable radar is on board and if the radar stacking from the ground is done with lateral evasion at the stacking altitude at a distance from the disturbance of not less than 10-15 km;

2-109/465 L and: - if crossing the front at the stacking altitude with passage between disturbances (radar flares) at a distance of not less than 25 km from the thunderstorm on each side;

- if crossing the storm front at a safe altitude at least 500 meters above the upper edge; and

- if in visual flight above the clouds, without turning into the cloud formation and zone of precipitation at altitudes safe for flight in the particular locality according to confirmation by the dispatcher and with those conditions mentioned in 6. above taken into account.

WARNING: In the absence of the flight conditions mentioned in 8. above and in the absence of radar control from the ground, the avoidance of a storm activity is permitted only for visual flight conditions at altitudes approved by a dispatcher.

9. Flying over air routes in mountainous regions is forbidden when:

- no radar control from the ground is available;
- the cloud system of a cold front is at the center of a low-pressure area;
- a wind greater than 15-20 meters per second blowing perpendicular to a mountain range on the flight route;
- it is not possible to gain an altitude more than 1,000 meters above a mountain or range at a distance of 60-100 kilometers before reaching the mountain or range.

10. To avoid the atmospheric turbulence caused by the jet streams, it is sufficient to change altitude by 200-300 meters now and then or to turn just slightly off course.

Flying the TU-134 Aircraft Through Bumpy Air

Areas where bumpy air can be encountered include both inside as well as outside cloud formations. When approaching an area of possible bumpy air, the captain must:

1. Check the tightness of the safety-belt connections.

2. Give the steward the order to have passengers stay in their seats and fasten their safety belts.

3. Switch off the autopilot, if it happens to be on, and balance the aircraft by means of the trim tabs.

4. At altitudes above 7,500 meters set aircraft speed to cor-

During an approach, a pickup by the aircraft to larger angles of attack will not be observed. At all Mach numbers and at all operational trim settings to limit-aft of 38% of MAC, the aircraft returns to the initial angle of attack without interference by the pilot.

If for some reason or other the aircraft has gone into a sudden stall, move the stick smoothly away from you into the neutral position and, once the aircraft has attained small angles of attack, eliminate the rolling by deflecting the ailerons.

WARNING: If the aircraft has dropped into a stall mode, the operating mode of the engines should not be changed. However, if, after coming out of a stall, the aircraft goes into a steep glide with rapid increase of Mach number, the engine speed must be reduced gradually, so as to keep the Mach number from exceeding 0.82 and indicated airspeed from exceeding 600 km/hr.

If the aircraft instruments show Mach numbers greater than 0.82 in a rolling motion, the roll correction should be made by means of the ailerons only, with the rudder in the neutral position, and do not forget that, at Mach numbers greater than 0.84, a rudder feedback occurs as a result of the roll.

6. When the aircraft is coming out of a stall, use the natural horizon for the purpose of orientation; in night flying and flying on instruments during the day use the gyro horizon, the turn and slip indicator, the airspeed indicator and variometer, angle of attack indicator and overload indicator.

7. Correct action by the pilot in coming out of a stall will prevent

the aircraft from going into a spin. If the aircraft suddenly loses altitude as a result of a strong downdraft, do not prevent the descent, but check closely on the airspeed and do not allow it to deviate far from the initial speed.

8. When bringing the aircraft down for a landing through bumpy air, maintain speed in circular flight just as under normal conditions.

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Flying the Aircraft During Icing Conditions

1. Before a flight, study the weather conditions along the intended flight route, particularly in areas of take-off and landing, and keep in mind that the majority of cases of icing occur during take-off and landing at altitudes below 5,000 meters.

2. If a take-off is necessary under conditions where icing is likely to occur, the windshield defroster and the engine air-duct-intake and engine-interior deicers may be switched on while taxiing.

3. The stabilizer de-icing system is switched on after lift-off. The operation of the stabilizer de-icing system is regulated according to the lighting of the signal lamp on the co-pilot's instrument panel and the rise of load current to, for example, 550 amps according to the A-3 ammeter on the electric power instrument panel. The complete operating cycle of the tail-unit de-icing system takes 120 seconds. The signal lamp lights for 20 seconds and is off for 100 seconds.

4. The wing and tailfin de-icer system is switched on after the engines have gone over into normal mode. The operation of this system is checked by the TTsT-13 temperature indicator; for various flight modes the air temperature should be within the limits + 70 to + 180°C.

5. Do not switch off the de-icing systems until after the aircraft is outside the icing zone or outside the cloud formation, and make sure first that there is no ice on the wing and tail unit.

6. The de-icing system for the air scoops, engines, wing and tailfin are to be switched on under the following conditions:

- during flight into a zone of possible icing (when the aircraft comes down into this zone);
- during an emergency landing in an icing zone;
- when white spots form on the leading edge of the wing or on the air scoops;
- when the icing signal lamps for the aircraft and engines light up.

WARNING: Flying into a zone where icing conditions are probable is not recommended when the meteorological conditions are complex, but if such a flight path is necessary, the captain should do everything possible to keep the time the aircraft is flying under icing conditions to a minimum.

Once the icing zone has been passed, the de-icing systems may be switched off.

7. When landing in an area with low cloud cover and icing conditions, do not shut off the de-icing system until you pass the first marker beacon before touchdown.

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WARNING: Before landing after a flight under icing conditions, one of the crew must make sure (as soon as possible) that there is no ice on the leading edge of the stabilizer. If there is ice present, the captain must, if possible, continue to fly in the icing zone with the tail-unit de-icing system switched on until the ice is removed. If it is impossible to remove the ice, land with flaps retracted and with extreme caution.

When flying on one engine (and when two generators have failed) under icing conditions, do not switch on the PO-4500 spare converter on the auxiliary panel. Check the ammeters for the load on the operating generators. In this case the load on each operating generator should not exceed 500 amps. At the completion of this flight, check the condition of the collector-brush unit in each operating generator.

Following a flight under icing conditions, carefully examine the engines and make sure that there is no damage to the bullet fairing, the guide vanes, compressor first stage blading or leading edge of the engine air scoops.

11. THE DESCENT

1. During the flight, the navigator must compute the time for initating descent on the basis of dispatcher information on the altitude of approach to the airfield, and must report this time to the captain.

2. The 81-83% mode is used to bring the aircraft down from an altitude of 8-12 kilometers to 5,000 meters, and the idle mode is used from 5,000 meters to the circling flight altitude. Down to 8,600 meters,

hold the Mach number at 0.80 to 0.82; below 8,600 meters, hold the speed at in indicated 580-600 km/hr. During this time, the vertical speed of the aircraft down to an altitude of 5,000 meters will amount to 10-14 meters per second, and 12-16 meters per second from 5,000 meters.

3. During a descent, avoid any abrupt change in engine operation, because abrupt changes in engine operation cause abrupt changes in cabin pressure, which can cause a sensation of sickness among the passengers.

4. When the aircraft flies into a cloud formation, the navigator must bring the aircraft to the original point of maneuver initiation; to do this he uses the radio compass and airborne radar, as well as the RSBN-2S or KURS-MTs-2 system for local radio navigation.

If the radiocompass readings are not consistent, the navigator must warn the captain of this and use the airborne radar to locate the airport, periodically reporting to the captain the bearing and distance of observed orientation points, and must, at the completion of each turn, report on what increase or reduction of the rate of descent must be made. When the aircraft is brought into the landing path, the captain must be informed of the time, altitude and airspeed at which the outer and inner marker beacons have been transited.

6. If necessary, the captain himself should communicate with the dispatcher service and request his position and radio bearing.

<u>WARNING:</u> When flying higher than 8,000 kilometers [meters], do not allow the engine operating mode to drop below 81 %.

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12. EMERGENCY DESCENT

1. If an emergency descent from cruise altitude is necessary (sudden, rapid drop in pressure or accidental leak in pressurized cabin, or a fire that cannot be extinguished, or where an immediate descent is necessary for other reasons), the following must be done:

- set the engine control rods to the "idle" position;
- at a speed no greater than Mach 0.82, shift the landing-gear extension valve to the extend positon and, without forcing the gear to the full down position, bring the aircraft sharply to a descent with an overload of $P_u = 0.5$ by bringing the pitch angle down to 15 degrees (main bogies of landing gear extend in 10-13 seconds). If the nose wheel bogie has not extended to the locked position, keep descending with the nose bogie in the almost fully extended position. (The nose bogie will move into the locked position after the airspeed has dropped below 470 km/hr.)

2. As you come down, do not let the airspeed go above Mach 0.82, by the machmeter, down to an altitude of 8,600 meters; at altitudes below 8,600 meters, keep the speed at 600 km/hr. With this method it should take 2 minutes and 40 seconds to make an emergency descent from 11,000 meters to 5,000 meters. During such a descent the aircraft remains completely stable and under control.

3. <u>After reaching a safe altitude, draw the stick smoothly back toward you to bring the aircraft into level flight, making sure that the loss in altitude during the pull-out is not less than 300-400 meters.</u>

As you pull out into level flight, be sure that you hold course, any change of which will show up in a banking of the aircraft.

4. During an emergency descent, the co-pilot must:

- keep an eye on the Mach meter and report any changes in its indication to the captain; beginning with 550 km/hr, report all increases in indicated airspeed;

- report any banking or drift from course by the aircraft to the captain.

2-113 13. GROUND-CONTROL APPROACH IN INSTRUMENT-LANDING MODE

1. Approach to the airport area is, as a rule, made through the outer marker beacon or the radio of the approach corridor with the ARK-11 automatic radio compass, by means of the RSBN-2S radio navigation system of local navigation or by means of airborne and ground radars.

2. The necessary flight path of the aircraft during descent, with the half-value of the wind taken into account, measured at the flight altitude, for a given vertical velocity is determined by the formula:

$$t = \frac{H_{esh} - H_{pod}}{V_v}; \qquad S_{ch} = (V_{cp} + \frac{W-V}{2})\, t_{ch};$$

where: t_{ch} = time required to descend to a given altitude "H";

H_{esh} = stacking altitude;

H_{pod} = altitude of approach to airfield;

S_{ch} = flight path during descent;

V_{cp} = mean air speed during descent;

W-V = equivalent wind at flight altitude;

V_v = vertical velocity.

Before initiating the descent from the stacking altitude, check the position of the variation index on the USh navigator's instrument (at zero).

As you come down, check the USh instrument readings and compare them with the readings of the "G" pointer of the UGA-1U [gyro indicator?]. If the two differ by more than 2°, level out and match up the system.

3. Bring the aircraft to the initial point of descent for the approach to a landing at the stacking position assigned by the flight controller according to the standard pressure of 600 mm Hg.

4. Switching the KS course-indicating system to the "MK"("magnetic heading") mode must be done in the vicinity of the airfield before initiating the maneuver for the landing approach.

5. If the usual radar checkpoints are present in the vicinity of the airfield, the approach for the landing is monitored with the ROZ-1 radar.

2-114/465 L 14. THE LANDING APPROACH AND THE LANDING

1. Once communications with the airport have been established and permission to approach for a landing has been received, all members of the crew will shift the altimeter dials over to airport pressure (and report

the shift-over to the captain).

Descent and maneuvering for the approach to landing are done by radio (see chapter on radio equipment) according to the approach for landing plan, or in a straight line from an initial altitude established by the particular airport.

The "Big Box" Landing Approach Method

2. The principal method of approach for a landing is by the "big box" method (large rectangular flight path). Depending of the angle of approach to the runway axis, the aircraft can be "written" into the plan of the big rectangular route at various points at the circle altitude, i.e, points which will guarantee minimum time for the approach to the landing. The point of initiation of descent must be chosen on the approach path to the airport in such a way that the aircraft will be flying at constant speed and altitude at the moment it turns for the approach along the axis of the runway.

3. After $1\frac{1}{2}$ minutes have elapsed, turn 180 degrees with a 15-degree bank and as you descend to 1,200 meters, hold the indicated airspeed to 500-450 km/hr and the rate of descent 10 meters per second. After coming out of the turn, drop to the altitude of the 400-600-meter circle. At the moment you pass the outer marker beacon, drop your indicated airspeed to 400 km/hr and give the co-pilot the order, "Extend the Landing Gear !"

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Once the signal lights go on to indicate the landing gear in the extended position, establish in the system a pressure of 210 (plus 10, minus 7) for 20-30 seconds, then set the landing-gear switch to the "neutral" position. When given the order by the captain, the co-pilot extends the landing gear, closes the cabin pressurization valves and reports to the captain. After the landing gear has been extended, drop the indicated airspeed to a steady 350 km/hr by reducing the engine rpm.

4. At a true relative bearing of 240° (120°) make the third turn with a 15° bank and an indicated airspeed of 350 km/hr.

5. After the third turn, extend the flaps 20° and reduce the indicated airspeed to 300 km/hr. The fourth turn is executed at a true relative bearing of 285-290° at 300 km/hr. After the fourth turn and before entering into the glide path, extend the flaps to 38°. When executing the automatic approach for landing with the BSU-3P, be guided by the chapters on radio equipment and the airborne BSU-3P system.

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WARNING: 1. If, when the flaps are extended, the lateral stability of the aircraft is disturbed and a considerable force is generated on the control stick from the ailerons, give the order to reduce the flap angle slowly. Then, once the pulsations of the flaps have been eliminated, re-establish the lateral stability of the aircraft and do not change the flap angles until touchdown. The descent is made at increased speed (10-15 km/hr above normal).

2. If, when the aircraft is in flight, the spoilers extend automatically and impair the lateral equilibrium of the aircraft, first check the position of the spoiler extend button bracket and if it has slipped off the latch, set the spoiler switch on "Forced Retraction". If the spoilers still do not

retract, use the flaps extended to 20° and speed about 10-15 km/hr faster than normal for the landing.

The speed for entering into the glide path and passing the outer and inner guide beacons should be 250-260 km/hr, indicated airspeed.

At the optimum glide path descent angle of attack of 2°40', the aircraft should pass the outer marker beacon at an altitude of 200 meters and the inner marker beacon at 60 meters.

6. Correcting the alignment of the aircraft with the centerline of the runway is done right after making the fourth turn . When required, turns must be coordinated.

7. After entering into the glide path, extend the ventral flaps and set the engines on the operating mode which will guarantee normal descent along the glide path.

8. Maintain speed at least 250-260 km/hr only the entire straight-line landing run until the levelling-out altitude is reached.

9. Levelling out is begun at an altitude of 8-10 meters; while levelling out, smoothly reduce the engine rpm. Throttling the engines at a higher altitude is not recommended, because it may cause a rapid reduction in altitude and airspeed. As the speed drops further, increase the pitch angle, bringing it to landing at 4.5 - 5° by the end of the levelling out run. When levelling out, avoid all rolling motions and avoid landing on one wheel. When the wheels touch down, extend the spoilers. Right after touching down, bring down the nose bogie and apply

brakes with a smooth depression of the pedals. The forward speed at the time the brakes are applied should not be greater than 225 km/hr. If necessary, release the brake parachute.

NOTE: The landing parachute is used as a means of shortening the rollout distance and is released in the following cases:
- landing on icy, snow-covered or flooded runway;
- to abort a take-off;
- when brake system fails;
- landing on a runway of limited size.

2-116/465 L If the main brake system fails, use the emergency brake system, but first release the main brake pedals.

WARNING: When using the emergency brakes, be sure to brake smoothly, because the emergency brake system does not have automatic brakes and fast braking could tear the tires from the wheels, particularly in the first half of the rollout. Also avoid unnecessary braking, since this leads to a rapid discharge of the emergency brake system. Use of the main and emergency brake systems at the same time is forbidden.

2-117/465 L 14. When released at an aircraft speed of not over 250 km/hr, the landing brake parachute will shorten the rollout by 13-15 %. Brake parachute separation should be at the end of the rollout before the turn into the taxi track. On clear, uncongested airfields the brake parachute may be released on the runway right at the end of the rollout, before the turn onto the taxi track.

WARNING: Extensive steering and turns with the parachute extened are forbidden, since this could damage the chute container doors, which could cause a premature, spontaneous release or failure of the chute the next time it was released.

15. At the end of the rollout, retract the spoilers, flaps and speed brakes. After retracting the lifting devices, depress and release the nose bogie steering switch to provide plus-minus 35° wheel rotation, then switch off the rudder loader switch.

In circling flights with short time intervals between landings, during an extended taxiing run with brakes applied or with frequent braking during taxiing in a cross wind, the brakes in the main landing gear bogies can overheat and fail to function properly. In order to avoid this, keep an eye on the brake temperature at all times during such handling of the aircraft.

Two successive landings with braking are permitted under the following conditions:

- circling flight with landing gear extended over a period of not less than 10 minutes;
- landing weight 33-35 tons and moderate braking at speeds of 170-180 km/hr.

After two successive landings the wheel parts and brakes must be force-cooled with water or compressed air down to a temperature of at least plus 40°C (104°F).

The parking brake may be used in starting, when testing the engines and during an inspection of the aircraft.

The parking brake must not be applied for an extended period of time right after an extended period of taxiing and braking.

Crew Duties During Landing Approach

16. Navigator:

- After permission has been given for landing approach, the navigator must tune the radio compass to the airfield radio station and check its operation and if it does not function properly, reports this to the captain;

- reports to the captain the flight altitude, airspeed and the time that turns are initiated;

- on a straight-line flight when the ground is not visible, reports the lateral drift from the runway centerline and gives course corrections;

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- reports to the captain the airspeed and flight altitude, and on the run-out he reports the center of the runway and the time when the distance to the end of the runway reaches 300 meters.

Copilot:

- assists the captain in piloting the aircraft, when instructed to do so;

- monitors the UHF communications with the dispatcher and conveys all received orders to the captain immediately (if audibility is poor);

- before the approach to landing, checks the fuel reserve and fuel system operation;

- extends the landing gear upon order of the captain;

- checks pressure in the emergency system (should be 210 kg/cm^2);

- checks switching-on of automatic brake system;

- checks position of nose-bogie steering-mechanism switch (should be in the "ON" position);

- upon the order of the captain, extends flaps, ventral flaps and reports doing so to the captain;

- checks to make sure that the cabin-pressurization valves are closed.

Steward:

- In the winter when the air temperature at the ground is below minus 5°C (23°F), before the aircraft lands at a terminal point or its base airport, the steward must drain the water out of the toilet tanks.

15. LANDING-ABORT FOR SECOND GO-AROUND WITH BOTH ENGINES OPERATING

1. Pulling-out for a second go-around with landing gear and flaps extended (38°) is permitted for any flight weight at any altitude above 50 meters.

2. Having received permission to pull out for a second go-around, the captain must:

- slowly shift the engines over to the take-off mode and notify the crew of the second go-around; give the order to retract flaps if they have been extended;

- bring the aircraft out of the descent by maintaining constant speed until the aircraft begins to climb and hold the landing approach bearing (do not allow speed to drop below the 250-260-km/hr gliding speed established for landing weights of 37-40 tons);

- after bringing the aircraft into a climb and the engines over to the take-off mode, give the order to retract the landing gear, then gradually increase airspeed;

- at an altitude of not under 80 meters and an airspeed of 330 km/hr, give the order to retract the flaps;

- continue to accelerate speed as the aircraft climbs. After reaching a safe altitude, obtain from the flight training officer instructions for further action.

2-119 3. As soon as the aircraft pulls out for the second go-around, the navigator must begin reporting the indicated airspeed for every 10 km/hr change and must monitor the holding of the computed landing approach heading.

4. When instructed to do so by the pilot, the co-pilot pilots the aircraft, allowing no rolling or drifting from course, retracts the flaps in two stages and reports execution to the captain.

16. APPROACH AND LANDING IN A CROSSWIND

During an approach for a landing in a crosswind, after the fourth turn and before touchdown, drift should be compensated only by a lead angle relative to the heading. At the moment of touchdown, turn the aircraft in line with the runway and hold the heading on the runway centerline by using the rudder and brakes. The airspeed during the glide in a cross and bumpy air should be 5-10 km/hr faster than under normal conditi

The landing speed should be 5-10 km/hr faster than that computed for a landing in the absence of the crosswind. Landing in a crosswind must be done with a very precise approach by the aircraft to the ground and a smooth touchdown. Abrupt levelling-out is not permitted under these conditions. The limiting admissible lateral wind component for a landing is 14 meters per second. If the landing parachute is to be used in a landing in a crosswind, the chute is released as follows: turn the aircraft toward the edge of the runway on the leeward side, then veer it along the edge of the runway so that the parachute will release over the unpaved ground, then release it.

If the aircraft has the tendency to rotate, which cannot be countered by a deflection of the pedals or use of the main brakes, one of the emergency brake levers should be used.

17. LANDING ON AN ICY RUNWAY

When a landing is made on an icy runway, the effectiveness of the brakes is sharply reduced. A landing on an icy runway must always be made with the use of the brake parachute. In this case the parachute must be released after touchdown and at a speed of not over 250 km/hr. During a landing on an icy runway the limiting-admissible value for a lateral wind component is 6 meters per second.

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18. TAXIING TO PARK POSITION AND ENGINE SHUTDOWN

1. At the end of the rollout, drop the cabin pressure by shutting off the switch on the co-pilot's instrument panel.

2. After taxiing to the park position, the captain should check to see that the brake operation is normal and that the pressure in the hydraulic accumulators is normal (210 kg/cm^2). Switch off the DR-134M yaw damper.

3. When the aircraft is taxied to the park position, it should be stopped 50 meters short of the position and wait for the signal to proceed.

4. When taxiing the aircraft keep an eye on the signals given from the ground. During the taxiing, the aircraft speed should not exceed the walking pace of the ground parking attendant.

5. The co-pilot and navigator must keep a watch out for obstacles and report all observed obstacles to the captain during the taxiing period.

6. After the taxiing run, when the aircraft has been stopped in front of the airport terminal platform or at the park position, the following must be done:

<u>By the captain</u>:

- aircraft held with brakes on;
- gives crew order to shut off unneeded (accessory) electric power outlets;
- shifts independent hydraulic system switch into the "OFF" position;

- switches spoiler switch to the "OFF" position;

- stops engines as instructed by the section titled, "Stopping the Engines;"

- after chocks have been put under wheels, releases brakes and locks control and aileron levers.

<u>WARNING:</u> Following flights, particularly circular flights, and taxiing to the park position, do not apply the parking brake until the brakes and wheels have cooled down, in order to avoid brake mechanism failures.

<u>By the co-pilot:</u>

- when ordered to do so by the captain, switches off the unneeded (accessory) electric power outlets;

- observes placing of chocks under wheels and reports execution to captain;

- requests connection of aircraft electrical circuit to airport power source;

<u>NOTE:</u> If airport electrical power source is not available, the aircraft power circuit may be used only for duty and night illumination, threshold illumination and required instrument power.

- switches off batteries and airport power after passengers have been disembarked and baggage unloaded.

<u>NOTE:</u> If airport power is available at intermediate airports (in winter with temperatures of -25° and below) the airport power may remain connected up to the aircraft power circuit in order to heat up the batteries.

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By the steward:

- after engines are switched off, switches off the main cabin lighting;

- checks to see that the electrical devices in the pantry, kitchen, and signalling devices are off, and that the thermos cocks are closed;

- shuts off all switches on the steward's panel after the passengers have disembarked; in hours of darkness, duty lights and ceiling lights at the entrance are left burning;

- when the aircraft is parked for a short period at an intermediate airport, switching on all illumination is permitted only if the airport power supply is switched on.

7. Leaving the aircraft is allowed only with the permission of the captain. Upon leaving the aircraft, all crew members must see that all switches and rheostats at their working areas are in the "OFF" position.

As long as the electrical circuits are in working order, the circuit breakers on the circuit breaker panels do not have to be switched off. Disconnect the aircraft electric power circuit by switching off the batteries, and switch off the airport electric power supply by means of the switches on the electric power control panel.

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B. EMERGENCY FLIGHT CONDITIONS

(Special Situations)

1. FAILURE OF ONE ENGINE DURING TAKE-OFF

1. The main indications that an engine has failed are:

- fuel and oil pressures drop below normal limits;
- increase or decrease of temperature of the gases;
- drop in engine rpm without change of engine control position;
- engine flutter.

2. An indication to the person piloting the aircraft that an engine has failed is the tendency of the aircraft to turn and bank toward the side of the failing engine.

3. Whenever an engine fails during the take-off run, the captain should either abort or continue the take-off, depending on the length of the runway, the weight of the aircraft and the atmospheric conditions:

- if the engine fails at an aircraft speed equal to or less than decision speed (for G = 44 tons, $V_{pr\ resh}$ (V_{dec}) = 235 km/hr under normal weather conditions), the take-off is aborted;

- if the engine fails at a speed greater than decision speed, the take-off is continued.

Determining the commitment speed for a take-off under other weather conditions than normal is done as described in the example (Section 3, page 41).

4. When aborting a take-off:

- bring the throttle controls of both engines to idle;
- extend the spoilers and release the drag parachute;
- apply the brakes forcibly;
- switch off the engine which has failed.

If there is a threat of collision with any obstacles, turn the nose wheels up to 35° and apply the brakes discretely. When the take-off is to be continued, the tendency of the aircraft to turn at the moment the engine dies can be countered during the remaining take-off and climbout by appropriate pedal deflection with simultaneous control stick deflection up to half way toward the side of the operating engine and the creation of a 2-3° roll toward the side of the operating engine.

5. Once you have attained the speed at which the nose wheel is lifted off the ground (for the given take-off weight), smoothly pull back on the stick and separate the aircraft from the ground.

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After the aircraft has lifted off and attained an altitude of 5 meters, retract the landing gear and climb smoothly, while holding a safe take-off speed ($V_2 = V_{lift\ off} = 260$ km/hr).

At an altitude of 120 meters in level flight, accelerate up to a safe speed (Figures 3-6, 3-7) and retract the flaps in steps. When a safe altitude is reached and when the airspeed is at least 280 km/hr, execute the first turn, with a bank of not more than 15°, in the direction of the operating engine, and then:

- shift the operating engine into the normal operating mode;

- switch off the engine which has failed and close the fire valve;

- close the pressurizing valve and proceed in accordance with the instructions in Section 14 (page 2-134).

NOTE: During circular flight with one engine out and flaps retracted, the rudder spring loader may be switched off if necessary.

Whenever the external signs and instrument indications that an engine has failed are accompanied by the lighting up of the light register marked "ПОЖАР" ("fire"), quickly shut off the burning engine and close the fire valve. Then proceed according to instructions in the section "FIRE ABOARD THE AIRCRAFT" (Section 4., page 2-125).

Failure of an engine directly upon lift-off or directly after lift-off causes a very strong tendency on the part of the aircraft to turn. In this case, quickly deflect the pedal and bank 2-3° toward the operating engine in order to hold the aircraft on its heading. Proceed as for the case of engine failure during a take-off run when take-off is continued. During the takeoff roll and climbout, forces on the rudder and ailerons are overcome without being removed by means of the trim-tabs.

During the entire take-off period, when one engine is out, the navigator regularly reports to the captain the speed of the aircraft, noting all changes in speed, particularly decreases.

The co-pilot contributes to the handling of the aircraft only when instructed to do so by the captain.

When a take-off is to be continued after one engine fails, once a safe altitude has been reached, proceed to the landing mode and land at the airport where you have taken off, or at the nearest emergency airport. If possible, bring the landing weight down to the admissible weight.

2. FAILURE OF ONE ENGINE DURING CLIMBOUT

When one engine fails as the aircraft is in a climb, the aircraft tends to turn in the direction of the failing engine and goes into a roll in the same direction. This tendency is easily countered by means of the rudder and ailerons.

If an engine fails at a low altitude before the first turn is executed, proceed as in the case of continuation of take-off.

2-124 / 55 L If an engine fails at low altitudes during climbout:

- use rudder and aileron controls to prevent aircraft from turning and banking;
- switch off the faulty engine;
- close the fire valve and the pressurizing valve of the faulty engine
- switch on the cross-feed valve and land at the nearest airfield.

The TU-134 aircraft can climb to 4,000 - 5,000 meters with one engine in the normal operation mode.

During a flight on one engine with flaps retracted, turns are coordinated with a banking of not over 15° in either direction and at a speed of not less than 330 km/hr.

When approaching to land, proceed as indicated in the section titled "Approaching to a Landing On One Engine."

3. FAILURE OF ONE ENGINE DURING FLIGHT

When one engine fails in cruising flight:

- keep the aircraft from turning and banking;
- hold the operating engine on normal rpm and switch off the faulty engine;
- close the fire valve and the cabin-pressurizing valve of the faulty engine;
- set the airfraft on an indicated airspeed of 430 km/hr;
- open the cross-feed valve and land at the nearest airport.

In order to guarantee an equal consumption of fuel from the right and left torsion-box integral tanks, the ETsN-45 pumps of the operating engine must be switched on and off periodically so that when the aircraft lands the difference in the amount of fuel in the right and left tanks will not be over 400 kilograms.

When the operating engine is in normal operating mode, the aircraft will drop from the cruising altitude with a gradually decreasing vertical speed until it reaches the flight ceiling with one operating engine (about 5,500 meters). After this ceiling is reached, continue the flight on normal engine rpm while maintaining indicated airspeed of 430 km/hr. In this case the aircraft will climb very slightly as the fuel is used up.

When the aircraft is flying under icing conditions, the navigator must check the load on the generators and if it exceeds 400 amperes on each generator, he must report to the captain the necessity of shutting off some of the current-consuming outlets.

2-125 4. FIRE ABOARD THE AIRCRAFT

1. If the light register "Пожар" (fire) and the red light come on, indicating the location of the fire (in the left or right engine pod or engine), the captain must:

- shift the engine control rod (on the side where the fire is indicated) to the "Останов." (stop) position;
- close the fire valve;
- close the cabin pressurizing valve;
- reduce speed to 340 km/hr;
- if the fire is not extinguished on the first attempt, depress the button "Включение огнетушителей" (fire-extinguishers on) a second time and then, if necessary, and if the fire is located in the engine pod, the button "Пожар в мотогондолах" (fire in engine pods), or the button "Включение противопожарной системы" (fire-fighting system on) once, and a second time if the fire is located inside the engine.

NOTE: The first action in the extinguishing of a fire in the pods is automatic.

2. If the first (second) attempt to extinguish the fire with the main system of extinguishers has been executed, and the system has

returned to the original position, then, if a second fire breaks out on the aircraft (signal lamp lights and "Fire" light register goes on), depress the button for switching on the unexpended pod or engine extinguishers.

3. If a fire is located visibly in the engine pods and the signal light and "fire" light register do not go on, switch on the fire-fighting system by hand, whereby the captain must:

- after finding the exact location of the fire, depress the lamp button of the engine pod in which the fire has been detected;

- proceed as instructed in 1. above.

In the case of a visual location of a fire, when the signal lamps do not go on, and the first (second) attempt has been made to extinguish the fire, the second (third) attempt necessitates:

- depressing the lamp-button "Fire in engine pods" for the pod in which the fire has been detected or depressing the button "Fire-fighting system on" for the engine in which the fire has been located. This opens the valve that feeds fire-extinguishing substance to the site of the fire;

- depress the button to switch on the unexpended extinguisher of the pod or engine;

- proceed as instructed in 1. above.

Once a fire has been extinguished, the "Fire" light register should go off, and if the main switch of the fire-fighting system is set to the "Выключено"(OFF) position and then to "Включено" (ON), the fire alarm system should return to the neutral position, and the lamp-button should go off.

2-126 The co-pilot should go into the passenger cabin, look out the portholes and determine the limits of the fire, and report to the captain.

NOTE: The system switch does not have to be thrown into the "OFF" position until 20 seconds after the extinguishers have responded; this allows time for the pressure in the system to equalize with that of the atmosphere. If there is pressure in the system, the electromagnetic valves will not open.

If a fire should break out in the cabin, the navigator and co-pilot must quickly put it out with the hand carbon-dioxide fire extinguishers, which are in the forward passageway and on the back wall of the passenger compartment. In such a situation, never allow the passengers to move to the back of the compartment, since this disrupts the rear center of gravity of the aircraft.

If a fire that breaks out during a flight cannot be extinguished, once this has been reported to the captain by the co-pilot, the captain immediately executes an emergency descent for a forced landing.

5. ELECTRICAL EQUIPMENT SYSTEM MALFUNCTIONS

Short Circuits

1. Short-circuiting to ground by the distribution bus bars or power cables can lead to a current cut-off in the main DC circuit of the aircraft. When a short occurs, the load current increases abruptly: the

pointers of the ammeters for the generators and batteries jump to the far right ("jump off the scale"); the voltage in the circuit drops abruptly, and the smell or smoke of burning insulation may be detected. In such a case, the navigator must switch off all the generators and report to the captain that the main electric circuit is out.

2. When the main DC circuit cuts off, the batteries are automatically switched over to the buses of the emergency circuit after the generators have been switched off; the supply of power from the batteries is monitored by the lighting up of the lamp labeled "приборы питаются от аккумулятора" (instruments supplied from battery).

2-127 / 65 L If the automatic switching device does not function, the navigator must switch the battery bus switch into the circuit.

3. Those instruments and assemblies which are powered directly from the batteries in the emergency operation are:

- main ARK-II radio compass
- pitot heater for instruments on pilot's panel
- SPU-7 intercom
- SGU-15 public-address system
- drag chute controls
- sound and light signals for cabin pressure drop
- PO-500 and SPO-4 converters
- cabin pressurization controls

- red light illumination in crew's cabin
- speed limit indicators
- automatic brake system control
- landing-gear and spoiler signals
- aileron and rudder trim-tab controls
- hydraulic system and cross-feed controls
- indicators of flaps, belly-flap and stabilizer
- landing gear controls
- engine starter controls
- power supply to the "Lotos" communications radio
- indicators for oil pressure and temperature and fuel pressure
- PT-125Ts converter for the AGD-1
- fuel pumps and gauges
- fire and main valves
- fuel pump operation signals.

The automatic circuit breakers for these assemblies and components are framed in yellow. The remaining current consuming elements are cut off after the generators are switched off and the emergency buses are switched over to battery.

4. If the batteries are fully charged and in good condition, they can supply the needed power to operate the assemblies and components connected to the emergency buses for about one hour of flight.

5. After switching over to emergency power supply, make an attempt to locate the fault in the electrical system and restore it to normal operation; this is done as follows:

- switch off all the circuit breakers on the circuit-breaker panels and electrical panels except the automatic circuit breakers framed in yellow;

- if there is the smell or smoke from burning insulation, try to track down the location of the fault and repair it;

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- switch on the generators, one at a time, and observe the indications of their ammeters and voltmeters; the batteries switch over to the main circuit automatically once one generator is switched on;

- alternately switch on the circuit breakers of those current consuming devices which are more necessary than others for continuing the flight and, checking the ammeter readings each time, check for the recurrence of smoke or smell of burning.

6. If the fault cannot be located and if the ammeters again jump to the far right when the generators are switched on, switch off the generators and prepare to land at the nearest airport, using only those instruments and assemblies switched into the emergency bus.

Generator Failure

The aircraft has four DC generators. If two of them fail, there may not

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be enough energy from the remaining two to supply all the current consuming outlets. The failure of generators and their disconnection from the aircraft power circuit are signaled by the red lamps on the navigator's electric power control panel and on the light register on the center instrument panel.

If one or two generators should fail, switch off the one or ones that have failed and check the load on the operating generators; if it is above 400 amperes, shut off the bus of the electrical convenience outlets and report doing so to the captain. Once these outlets have been switched off keep monitoring the load on the operating generators to make sure that it does not exceed 400 amperes. If it does exceed this value, the members of the crew, on the captain's orders, must shut off the less important electrical outlets.

6. LANDING GEAR RETRACTION AND EXTENSION SYSTEM MALFUNCTIONS

Incomplete Retraction

1. If, when the landing gear is being retracted, the pressure in the system is 200-210 kg/cm^2 and one or more signal lamps fails or fail to
2-129 light up, or all the lamps indicating retracted position light up, but after the handle of the PPNG-15 switch has been turned to the original position, one or more of these lamps goes or go out, this indicates that the bogie for which these lamps signal retraction has not fully retracted. In this case the airspeed must be reduced to 350 km/hr, the landing gear must be extended by means of the primary system and retracted again.

2. If the second attempt to retract the bogie still does not bring it to the locked position and the signal lamps light but then go out or still do not light when the PPNG-15 switch is shifted to the neutral position, report to the flight controller and act according to his instructions.

WARNING: A flight must not be continued to destination if the landing gear bogies are not in the locked position, but are being held in the retracted position by the pressure in the hydraulic system.

Landing Gear Extension Malfunctions

3. If, when the landing gear is extended, one of the signal lamps indicating extension does not light up:

- make sure that the lamp has not burned out; this is done by pressing the button to check if all the lamps are good;

- shift the handle of the PPNG-15 switch to the neutral position and make sure that the pressure in the main hydraulic system has not dropped below 200-210 kg/cm^2.

WARNING: If the pressure in the system has dropped below 200 kg/cm^2, extend the landing gear by means of the emergency system in accordance with the instructions in the section titled, "Emergency Completion of Landing-Gear Extension."

- reduce airspeed to 350 km/hr;

- again shift the switch handle to the position, "Extend," ("Выпущено") and, while holding it in this position for about 8-10 seconds, make sure that the pressure in the system has returned to 200-210 kg/cm^2 following the drop in pressure, then check the position of the nose bogie through the window in the deck on the basis of the position of the mechanical indicator (indicating marker); when the gear is fully extended the indicator should be turned to the white side.

4. If these procedures do not lead to the lighting of the signal lamp, the extension of the landing gear must be completed by means of the emergency hydraulic system. The closing of the main landing gear doors after extension indicates that the landing gear is in the locked position (can be followed visually).

?-130 Emergency Completion of Landing-Gear Extension

5. If, at an airspeed of 350 km/hr, the landing gear, being extended by means of the main hydraulic system, does not move all the way to the locked position and the green light does not go on, and if a visual observation reveals that the nose bogie has not fully extended, the landing gear must be brought into the completely extended position by means of the emergency hydraulic system.

Before extending the landing gear by means of the amergency system, make sure that the handle of the PPNG-15 switch, which controls the main system of extension and retraction of the landing gear, is in the center (neutral) position, then press the button of the handle labeled "Шасси аварийно" (Landing gear emergency) on the right engine panel, turn the handle all the way up and leave it in the up position.

If the signal lamp does not light, repeat the procedure described in point 3, paragraph 4 of the section titled "Landing-Gear Extension Malfunctions."

NOTE: 1. The landing-gear extension handle remains in the extended position until the aircraft comes to a halt at its parking location. After the aircraft has come to the stop, the handle is returned to the original position only after the reason for the use of the emergency system has been clarified.

2. If the emergency system breaks down, the landing gear can be extended manually by means of a pump (emergency extension handle out) which takes about 15-20 minutes.

WARNING: In order to guarantee full pressure in the hydraulic system after the aircraft lands, one of the engines must remain in operation until measures have been taken to prevent collapse of the landing gear.

7. POSSIBLE FAILURES OF THE DR-134M YAW DAMPER

1. If the yaw damper fails with the RAU lever fully extended, the pointer of one of the ratio meters will position itself in an extreme position, whereby the aircraft will undergo involuntary side-slipping accompanied by a marked banking.

The side-slipping must be corrected by means of the pedals, and the banking by means of the ailerons.

Then, while in the level flight mode, shut off the faulty channel of the yaw damper (the green light on the PNK should go out). The RAU lever of the faulty channel should be in the neutral position.

Continue the flight with the one channel on.

2. When switching off a damper make sure that you quickly rebalance the pedals at the moment you shift the RAU lever into the neutral position.

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465 L If the RAU lever does not shift into neutral, balance the forces on the pedals and continue the flight with the pedals shifted from the neutral position.

3. When the aircraft undergoes yawing and rolling oscillations and rudder flutter (pointers of both ratio meters fluctuate chaotically, so that it is impossible to tell which channel is faulty), switch off both channels and switch them on again alternately to tell which is faulty; then switch off the faulty one. Continue the flight on the good channel.

<u>NOTE</u>: When both channels are out during a flight, the tendency toward lateral oscillation is greatly increased and for this reason abrupt deflections of the rudder and ailerons should be avoided.

7(a). <u>AP-6Ye Autopilot Failures</u>: Failure of the AP6Ye is accompanied by a rudder shift to one side, which leads to a rolling, yawing, pitching or diving by the aircraft. In all such cases, the autopilot must be switched off immediately and the aircraft brought back into the original flight mode. Continue the flight with the autopilot switched off.

8. PEDAL CONTROL OF RUDDER WITHOUT BOOSTER ASSIST

1. Pedal control of rudder without booster assist in flight is employed:
- when main and independent hydraulic systems fail;
- when any type abnormality occurs in the rudder system (spontaneous movement of pedals, making control difficult).

2. The switch to pedal control with the booster off is made automatically when the pressure in the main and independent hydraulic systems drops below 7 kg/cm^2, or when the booster must be switched off.

3. Whenever the aircraft is flying with the booster shut off, the emergency cross-feed valve must be switched on in order to reduce the load on the pedals.

4. When the booster is shut off, or fails, the DR-134 M yaw damper automatically cuts off.

2-131a / 465 L 9. LANDING WITH NOSE WHEELS RETRACTED

1. When landing with nose wheels retracted:
- report to the flight controller the failure of the landing gear, obtain permission to land and instructions of flight controller;
- reduce the flight weight as much as possible by reducing the fuel supply down to 2,000 kilograms in case it is necessary to make a second go-around. Check the fuel reserve by the fuel gauge on the combination dial;

<u>NOTE</u>: Under difficult approach to landing conditions, such as zero visibility during daylight or when the landing is to be made at night, additional fuel may be kept in the tanks at the time of landing, with the permission of the captain.

- prepare portable fire extinguishers in the compartments;
- depressurize the aircraft cabin;
- prepare doors and hatches for the escape of passengers.

2. Before passing the outer marker beacon, create the maximum admissible rear center of gravity by shifting cargo, baggage or mail from the front baggage compartment into the rear of the aircraft, remembering that shifting 100 kilograms of cargo from the forward baggage compartment into the rear baggage compartment shifts the cnnter of gravity back by 1.2 % of the mean chord for landing weights of 35 tons.

If the maximum admissible rear center of gravity cannot be obtained by shifting cargo, baggage or mail to the rear, if not all of the passenger seats are occupied during the flight, seat some of the passengers in the back row of seats, remembering that shifting one passenger from the first row to the back row shifts the center of gravity back by 0.6 %.

2-132 Switch on the light signals, "Fasten Seat Belts", in the passenger compartment, and the steward checks to see that all passengers have done so.

3. When instructed by the captain, the navigator switches off the unneeded electrical outlets and goes into the passenger compartment, takes an empty rear seat and fastens the seat belt; if no rear seat is empty, he sits on the divan in the rear vestibule. The shift of the navigator from his working station to the rear seat shifts the center of gravity by 1.0 % of the mean chord.

4. Refine the computed landing procedure as you pass the inner marker beacon, then extend the landing flaps all the way.

5. As a rule, landing with the nose wheels retracted is done on a prepared stip of ground. If the strip of ground has not been so prepared, land on the concrete runway.

6. Flareout is initiated at the usual altitude. Make a normal landing, depress the spoiler control, release the landing parachute, switch off the engines and close the fire valves.

While keeping the nose of the aircraft from putting down, smoothly apply the brakes as long as the elevator remains effective. Before letting the nose down, disoontinue braking and release the parachute. On the run-out, after extending the spoilers and releasing the parachute, do not apply the wheel brakes if the runway or ground strip is 1,600 meters or more in length. At the moment the nose of the fuselage touches the ground, the fire-extinguishing system is automatically switched on.

10. LANDING WITH ONE MAIN BOGIE RETRACTED

All prelanding preparations are the same as for landing with the nose wheel retracted, plus:

- at airfields which have foam available, land only on the concrete runway;

- flareout and holding off are done with a banking toward the extended main bogie;

- land with the good bogie between the canterline and shoulder of the runway;

- after touching down and extending the spoilers, switch off the engines; let the aircraft down on the nose wheel, give the co-pilot the order to close the fire valves; release the landing parachute; tilt the stick toward the extended main bogie and use the ailerons to prevent the wing tip from touching the ground.

During the run-out, the moment the wing tip on the side of the retracted main bogie touches the ground, apply the emergency wheel brakes of the extended main bogie. At the moment the wing touches the ground, the fire extinguishing system switches on automatically.

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11. FORCED ROUGH-FIELD LANDING

In all cases where the captain of the aircraft is forced into the decision to land outside an airport, the landing should always be made with the landing gear extended.

Before landing, and if there is time, tell the navigator and the stewardess to go into the passenger compartment.

If there are children without seats in the aircraft, the navigator and stewardess must take every possible measure to protect them from violent impact during the landing; after the aircraft has landed, the navigator and stewardess should open the exit doors and the escape hatches, if possible.

The landing should be made with the minimum rate of descent (at maximum landing angle until the tail skid shoe touches down).

Switch off the engines before touchdown. At the moment the aircraft touches down, release the landing parachute and spoilers. Do not pull back on the stick. Apply the main brakes and, if necessary, the emergency brakes.

Once the plane comes to a stop, switch off the batteries and take all possible measures to evacuate passengers, mail and cargo from the plane.

12. BELLY LANDING

1. A belly landing is made only on the ground.

2. If possible, obtain the maximum rear center of gravity before landing. The captain gives the command, "Prepare for belly landing. Passengers fasten seat belts !" Those crew members who are not directly involved in the landing procedure will go to the passenger compartment when ordered to do so by the captain.

3. After the fourth swing, extend the flaps 20 degrees, and after passing the inner marker beacon extend the flaps to 38 degrees and set the indicated airspeed at 250-260 km/hr (for weights of 37-40 tons).

4. In computing the landing procedure, make sure that the reduced drag resulting from the retracted landing gear does not cause an overshoot during landing.

5. Before landing, switch off the engines; the co-pilot closes the fire valves, the navigator cuts off the aircraft electric power circuit by switching off the generators.

6. During a forced belly landing, all three fire extinguishers are automatically switched on to prevent a breakout of fire.

7. After the aircraft comes to a stop, the crew members must aid the passengers in leaving the aircraft through the door, cargo and emergency hatches and, if a fire has broken out in the aircraft and people have been injured, the crew members must take all measures to aid the victims and to put out the fire.

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15. LANDING WITHOUT EXTENDING LANDING FLAPS

If the landing flap extension system fails, land without the landing flaps extended, and with the belly flap extended.

Airspeed at the execution of the 4th swing should be 330-340 km/hr, during the glide 280-290 km/hr. The minimum airspeed on the straight landing path with flaps retracted must not drop below 280 km/hr. Landing speed is 255-260 km/hr. After landing, extend the spoilers, use normal braking and release the landing parachute.

Since extending the belly flap reduces the levelling-out and holding-off distance, the belly flap must be extended when a belly landing is made.

The belly flap is extended on the straight path when the transition is made to visual flight. Extending the belly flap necessitates increasing the engine rpm in order to maintain the gliding speed. The glide and the landing are made with pitch angles larger than those used in a landing with flaps extended to 38°.

14. LANDING APPROACH AND LANDING WITH ONE ENGINE

The approach and landing with one engine operating is, as far as the flight procedure is concerned, practically the same as an approach and landing with two engines. The swings during the approach are executed both to the side of the operating and to the side of the inoperative engine with a bank of up to 15 degrees and an airspeed of not under 330 km/hr.

The landing gear is extended before the fourth swing when the airspeed is 330 km/hr.

The fourth swing is also executed at 330 km/hr.

After the fourth swing at a speed of 330 km/hr, extend the flaps 10 degrees and reduce speed to 270 km/hr and 280 km/hr, respectively, for landing weights of 37 and 40 tons. The same speeds apply for the glide path (up to the moment of levelling out).

The approach and landing with one engine is executed with the rudder spring loader switched off.

15. LANDING ABORT AND SECOND APPROACH WITH ONE ENGINE

A go-around on one engine is possible at an altitude of not less than 70 meters, with 10 percent flap and belly flap retracted. Once the permission has been granted for the go-around:

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1. Shift the operating engine into the take-off mode;

2. Hold airspeed at initial pull up speed but not less than 270 and 280 km/hr, respectively, for landing weights of 37 and 40 tons.

Level off and, after the engine has assumed the take-off mode, retract the landing gear and begin to climb at a speed of 270 - 280 km/hr. In order to obtain the most advantageous conditions for a rapid climb and maximum controllability, use the recommended banking angle of 2-3 degrees on the side of the operating engine with a steady climbout.

3. When the aircraft reaches an altitude of at least 100 meters, level out and, at a speed of 280 km/hr, retract the flaps in steps and make the first swing at a safe altitude. Then shift the engine into its rated rpm and repeat the approach for the landing.

16. LANDING WITH A 44-TON MAXIMUM PERMISSIBLE LOAD

In exceptional cases the aircraft may land with the 44-ton maximum admissible load on concrete strips which are in normal condition of use.

In the approach for the landing, after the fourth swing has been executed, the indicated airspeed during the passage of the inner marker beacon must be no less than 270 km/hr (38^{o} flap, 40^{o} belly flap). Landing speed is 250 km/hr. When landing with maximum load, use the spoilers and brake parachute on the landing run. After the landing, examine the landing gear and airframe structures, particularly those places where the landing gear is attached.

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17. GROUND EMERGENCY EVACUATION OF PASSENGERS AND CREW BY MEANS OF INFLATABLE SLIDES, EMERGENCY CHUTES AND (KNOTTED) ESCAPE ROPES

For emergency cases when a rapid evacuation of passengers and crew is necessary when the aircraft is on the ground, and when the necessary ground evacuation equipment is not available on the ground, the aircraft carries an emergency TN-3 inflatable slide (in the galley-pantry area next to the entry door on the left side), a canvas chute (next to the emergency door on the right side) and escape ropes above all emergency hatches.

1. To prepare the inflatable slide for use:

- open the entry door all the way;

- remove the cover marked "inflatable slide" in the galley-kitchen area and lay the cover aside;

- take the slide in its canvas cover to the entry door;

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- fasten the ends of the straps to the special locks in the door embrasure and eject the slide and its cover out of the aircraft.

Make sure that the connecting hose screwed into the slide and into the carbon dioxide bottle has not been broken.

When ejecting the cover and slide out of the aircraft (after fastening the straps to the locks) pull the line to withdraw the pins out of the shafts on the canvas cover; the cover comes apart, and the slide will unwind and fall out to the ground;

- vigorously turn the handle of the carbon dioxide bottle valve. The slide will inflate in 10-15 seconds to a excess pressure of 0.4 - 0.5 atm and assume its correct position at an angle of 45°.

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NOTE: When there is a strong cross wind or when the ground is covered with rocks, tree stumps or mounds, one or two members of the crew should descend to the ground by the knotted rope on the slide and guide the slide by its lower end in order to prevent it ffom drifting under the aircraft or getting stuck on some protruding obstacle.

- one or two members of the aircraft crew go down first and help the passengers come down the slide.

Once the preparations for evacuation have been completed, the evacuation of the passengers is carried out without interruption.

WARNING: 1. Before passengers are evacuated, the steward must inform them of the necessity of avoiding sharp objects, of removing eye glasses, high-heeled shoes, and explains how they should go down the slide, either sitting up or lying on their backs.

2. The evacuation of 72 passengers with one TN-3 slide takes only 3-4 minutes.

3. If there is a large fire in the vicinity of the entry door it is better to use the canvas chute instead of the inflated slide. The chute can be attached at both the main (left) door and the emergency (right) door.

2. The canvas chute is prepared for use as follows:

- open either the main (left) or the emergency (right) door all the way;

- remove the chute in its canvas packing from the fasteners near the emergency (right) door, remove it from its packing and place it at the embrasure of the entry or emergency door;

- attach the shaped fasteners on the chute to the special locks in the door frame;

- place the shaped chute insert on the threshold and let chute and the rope drop to the ground;

- first, two crew members go down the rope and, drawing on the aid of the physically healthy passengers, draw the chute by the loop into the correct position, and assist the people in sliding down the chute to the ground.

2-137/465 L Once the preparations have been completed, the passengers must be evacuated quickly.

To hasten the evacuation from the aircraft to the ground or to a water surface when the inlet and emergency doors are jammed as a result of the emergency landing, the aircraft can be evacuated through four escape hatches (above the wing on the right and left sides of the aircraft) with the use of escape ropes (capron tapes) with knots.

4. To break out the emergency ropes:

- open the hatch;
- throw the rope through the hatch or air vent down to the ground.

<u>NOTE:</u> In order to prevent rope burns on the hands (when climbing down the escape rope), use the knots in the rope, which are spaced every half meter.

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